# For the Planet, the Animals, or Oneself? Measuring Individuals' Motivations to Restrict Meat Consumption and Encouraging Dietary Change

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Alexandra Scharmer

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## Dedication

For a younger version of me who was not sure how I would get this far, and for the current version who can hardly remember her. Time, curious time.

## Abstract

Following a vegetarian or vegan diet is associated with a wide range of positive outcomes in health, environmental, and animal-welfare domains. Although the last three decades have produced a large amount of research examining the themes in vegetarians' and vegans' self-professed motives, there has been a dearth of quantitative research examining these motives and connecting these motives to psychological theories. In the present studies, I (1) develop a theoretically grounded conceptualization of motives to follow a plant-based diet, (2) create a psychometrically validated instrument with which to measure these motives, (3) expand these constructs to encapsulate omnivores' motives for reducing their meat consumption, and (4) design a psychological intervention aimed at decreasing omnivores' meat consumption using persuasive messages matched to individuals' own motives for reducing meat consumption. I found that a four-factor model of motives (animal welfare, environmental, health, social) best describes the data and fits with functionalist theory. Then, I tested whether matching to these motives in omnivores resulted in greater intentions to reduce meat consumption, more negative attitudes towards meat, and selecting meat-free options for a hypothetical meal. I found limited evidence for a matching effect but did find some evidence that environmental appeals are generally more effective than other types of persuasive messages.

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# 1. Introduction

Following a vegetarian or vegan diet has a wide range of positive consequences for both the individual and for other living beings. Thus, understanding the motivations of individuals who have successfully followed plant-based diets for an extended period of time can be useful in informing the goals that might best enable individuals who do not follow plant-based diets to reduce their consumption of animal products. Further, understanding motivations in this domain can inform our understanding of other impactful repeated behaviors related to both health and environmentalism, such as transportation choices (e.g., walking or bicycling) and waste-disposal behaviors (e.g., recycling or composting).

## 1.1. Benefits of plant-based diets

First, there are clear health benefits associated with vegetarian and vegan diets. On average, individuals who do not consume meat have lower cholesterol levels and body mass indices (Key et al., 2006), and adopting a vegan diet can reduce the risk of serious conditions such as diabetes (Tonstad et al., 2013) and cardiovascular disease (Derose et al., 2000; Macknin et al., 2015).

Second, by a number of metrics, the agricultural processes involved in producing meat products emit more greenhouse gases than any other food type and is more detrimental to the environment than is the production of plant-based foods (Clark & Tilman, 2017). Further, eating less meat is one of the most effective and feasible ways for individuals to decrease their carbon production (Jungbluth et al., 2000; Wynes & Nicholas, 2017). Scarborough and colleagues (2014) examined the greenhouse gas emissions from the actual diets of 65,000 individuals and found that meat-eaters' diets

resulted in approximately twice as many greenhouse gas emissions as the diets of vegans. Given that climate change is arguably the largest problem faced by humanity and that the effects of anthropogenic climate change are predicted to have catastrophic consequences in the near- and long-term future (IPCC, 2019), from an environmental perspective, individuals' meat consumption is an important dietary behavior to target.

Third, animal activists have long touted the ethical consequences of a vegetarian or vegan diet. As early as the 18th century, Jeremy Bentham contemplated the morality of eating animals (Bentham, 1789/1907). Although there is a debate among philosophers about the ethical perspective underlying a moral decision to abstain from consuming animals (e.g., utilitarianism, rights-based deontology, contractualism, virtue ethics, common-sense morality, religious moralities; Matheny, 2003), many come to the same conclusion that a plant-based diet aligns with their moral principles (e.g., Regan, 1980; Singer, 1980). Estimates of the actual number of animals saved are complicated; one model predicts that each year a vegetarian saves between 371 and 582 total animals (including land animals, shellfish, feed fish, etc.; Sethu, 2012) but others suggest the numbers are much lower, closer to 95 animals annually (King, 2015). Regardless of the exact estimate, minimizing the number of animal deaths per year is one compelling reason to adopt a more plant-based diet.

Fourth, there are additional psychological benefits of adopting a plant-based diet. Vegetarian and vegan identity can be integrated into an individual's self-concept (Romo & Donovan-Kicken, 2012; Rosenfeld & Burrow, 2018) and provide feelings of ingroup security (Ruby et al., 2013). Avoiding meat can also help some individuals to avoid the unpleasant emotion of disgust (Fessler & Navarrete, 2003; Loughnan et al., 2014).

Overall, there are clear health, environmental, ethical, and psychological benefits to reducing one's consumption of animal products. Therefore, the goal of the present line of research is to understand, from a functionalist theoretical perspective, individual's motivations for eating predominantly plant-based diets and leverage these motives to encourage omnivores to decrease their meat consumption. Thus far in this area of research, the theoretical framework has lacked strong psychological roots, and I aim to address this shortcoming.

## 1.2. Conceptualizations of vegetarian motivations

The above arguments are very similar to the motives that vegetarians or vegans report in qualitative, bottom-up studies of their motivations. A number of studies differentiate between individuals who are motivated by their own health as opposed to broader ethical concerns related to animal welfare (e.g., Jabs, Devine, & Sobal, 1998; see Ruby, 2012 for an overview). Recent research suggests that animal welfare, health, and environmental concerns are the three most common motivations (Hopwood et al., 2020; Rosenfeld, 2018). A summary of each motive follows.

### *1.2.1. Health motives*

In much of the literature, health motivations are construed as self-focused; vegetarians with health motives are focused primarily on the personal benefits they can obtain from their diet (Fox & Ward, 2008b; Jabs et al., 1998; Lindeman & Sirelius, 2001). Although health motives are occasionally broken down into more specific health goals such as avoiding illness or losing weight (Timko et al., 2012), most studies include all health benefits in an over-arching motive (Janssen et al., 2016). Health-motivated vegetarians also tend to remove meat from their diet gradually (Jabs et al., 1998) and are

less strict in adherence to their diet than are animal-welfare vegetarians (Ruby, 2012; White et al., 1999). Additionally, people who eat low amounts of meat, but do not entirely abstain, do not differ from vegetarians and pescatarians on health motives (Hagmann et al., 2019).

### *1.2.2. Animal welfare motives*

Animal-welfare-motivated vegetarians are often viewed as more other-focused. That is, they care about their impact on other living beings as opposed to the way that their diet impacts themselves and their daily life (Lindeman & Sirelius, 2001; Whorton, 1994). Unlike vegetarians or vegans who are primarily motivated by health concerns, those motivated by animal welfare are more likely to abruptly remove meat from their diet and are also more likely to stop consuming other animal products such as dairy and eggs (i.e., transtion to veganism; Beardsworth & Keil, 1991; Jabs et al., 1998). They also report stronger conviction in their vegetarian diet (Hoffman et al., 2013). Compared to health-motivated vegetarians, animal-welfare vegetarians are also more likely to be disgusted by meat, leading to more strict abstinence (Arora et al., 2017; Rozin et al., 1997).

### *1.2.3. Environmental motives*

Environmental- and animal-welfare-motivated vegetarians are occasionally grouped together as "ethical vegetarians" because they are more inherently other-focused (Lindeman & Väänänen, 2000; Rosenfeld, 2018), although they differ in the relevant "other." Environmental vegetarians tend to remove meat and animal products from their diet in an attempt to reduce carbon emissions or to mitigate resource scarcity (e.g., deforestation; Janssen et al., 2016). The prevalence of environmentally-motivated

vegetarians varies greatly between samples; some studies find environmental motives relevant for a small minority of participants (Dyett et al., 2013), whereas others have found it to be one of the most prevalent motivations (Janssen et al., 2016; Kerschke-Risch, 2015). Nevertheless, this emerging motivation is important to consider when studying vegetarian motivations.

#### *1.2.4. Other motives*

Apart from these three primary motivations, some individuals are motivated by other factors. For example, religious traditions such as Buddhism and Seventh Day Adventism include tenets about avoiding meat (Fox & Ward, 2008a). A number of studies have found that religion can play an important role in the decision to abstain from eating meat (Potts & White, 2008; White et al., 1999). Religion is the fourth most prevalent motive for following a vegetarian diet (Rosenfeld, 2018; Ruby, 2012).

Additionally, aversion to the smell or taste of meat motivates some vegetarians (Fox & Ward, 2008a). Hamilton (2006) found that ethically-motivated vegetarians are often specifically motivated by avoiding violence generally, and these people also tend oppose hunting for sport, capital punishment, and nuclear weapons. Pets can also motivate this dietary choice; individuals who have pets and empathize with them are more likely to be vegetarian (Preylo & Arikawa, 2008). A recent line of research also emphasizes the role of social identity in adopting and maintaining a vegetarian diet; individuals motivated by social identity concerns want to be viewed positively by group members and fit in with their vegetarian peers (Plante et al., 2019). Last, Hoffman and colleagues (2013) also surveyed individuals who identified saving money, their

upbringing, politics, and taste as motivations. However, these less common motives are also studied much less frequently; thus, the literature in these areas is somewhat limited.

### 1.3. Conceptualizing the vegetarian identity

Although much of the work surrounding vegetarian motivations has been done on health, animal, and environmental motives, there is a notable recent line of research on the broader construct of vegetarian identity. Rosenfeld and Burrow (2017b) propose the unified model of vegetarian identity (UMVI)[1]. This model attempts to describe the totality of an individual's vegetarian self-concept. The motivation component is of particular interest to my present line of work.

The UMVI groups motivations into three categories: prosocial, personal, and moral (Rosenfeld & Burrow, 2017b). Notably, these categories diverge from those offered in much of the previous literature (i.e., health, animal welfare, environmental). In the UMVI, prosocial motivation is the "extent to which a desire to benefit something beyond oneself is a reason for being vegetarian" (Rosenfeld & Burrow, 2017b, p. 85); this can include helping animals, the environment, or even other humans. Personal motivation is the "extent to which a desire to benefit oneself is a reason for being vegetarian" (Rosenfeld & Burrow, 2017b, p. 85); health and religious motivations generally fall into this category and this is generally a goal-directed motivation. Last, moral motivation is the "extent to which beliefs about rightness and wrongness is a reason for being a vegetarian" (Rosenfeld & Burrow, 2017b, p. 86). Again, aspects of animal and environmental motives can fall into this category. Rosenfeld and Burrow

[1] This model has ten dimensions: historical embeddedness, timing, duration salience, centrality, regard, motivation, dietary pattern, label, and strictness. The motivation dimension is the most relevant for the present line of research.

(2018) recently created a measure of vegetarian identity that includes these three motivations and validated it in a vegetarian sample (Rosenfeld, 2019).

### 1.4. Previous intervention approaches

There is a dearth of research using motivational components to encourage individuals to decrease their meat consumption. However, there are a few relevant experimental approaches worth understanding. In a recent systematic review, Harguess, Crespo, and Hong (2020) identified articles containing experimental interventions to reduce meat consumption. Additionally, there have been a few more relevant interventions published in the time since they completed their literature review.

Only a few interventions have focused on any factors outside of the individual psyche. Sparkman and Walton (2017) used dynamic norms in an intervention. They told participants in the dynamic norm condition that Americans are increasingly reducing their meat consumption; this manipulation elicited greater intentions to reduce meat consumption and resulted in more participants ordering meals that did not contain meat in a restaurant setting than the static norm condition. Also, requiring participants to opt-out of a meatless meal by making it the default selection increased the frequency of meatless meals being selected (Campbell-Arvai et al., 2014).

The bulk of previous interventions instead involved personal factors, rather than normative influences or nudges. Providing information about the negative health impacts (Fehrenbach, 2015), environmental impacts (Graham & Abrahamse, 2017), animal welfare impacts, or any/multiple impacts reduced intentions to eat meat (Carfora et al., 2019; Cordts et al., 2014; Scrimgeour, 2012).

It is important to note that informational campaigns only had lasting behavioral effects over time when participants consistently engaged with the intervention content, for example, by receiving daily text messages or journaling (Amiot et al., 2018; Carfora et al., 2017a, 2017b, 2019; Loy et al., 2016). However, Campbell-Arvai and colleagues (2014) found that information-only campaigns had no effect on meal-selection decisions, nor did they have an incremental effect when added to other interventions. In another recent study, Piester and colleagues (2020) found that sustainability appeals were effective only for women. Generally, there is mixed success for informational interventions, but they are most effective and result in the more lasting change when participants repeatedly and actively engage with the messages.

Another popular type of intervention attempts to evoke emotions related to meat consumption or to prompt cognitive dissonance (Harguess et al., 2020). These interventions are relatively successful in reducing willingness to consume meat, but there is limited evidence about their impact on actual behaviors. In several studies, Kunst and colleagues successfully induced empathy by reminding participants that meat used to be a living being, resulting in lower intentions to eat meat than a control condition (Kunst & Hohle, 2016; Kunst & Palacios Haugestad, 2018; Zickfeld et al., 2018). Tian, Hilton, and Becker (2016) found that cognitive dissonance, evoked by presenting images of a cow headed to a slaughterhouse, reduced participants' willingness to eat meat; dissociating the animal from the meat also results in increased willingness to consume meat (Kunst & Hohle, 2016). Disgust, either prompted by images of the slaughtering process or broad associations with pathogens, lead to decreased willingness to consume meat than a control condition (Kunst & Hohle, 2016; Tybur et al., 2016). Generally, these

interventions are relatively successful in reducing willingness to consume meat, but there is little evidence that they lead to actual behavior change; thus, considering other potentially more powerful interventions is a necessary area for further research.

Some interventions were matched to individual difference variables, but the success of these interventions was limited. Verain, Sijtsema, Dagevos, and Antonides (2017) tailored messages about the health, sustainability, price, taste, and convenience of reducing one's meat intake to individuals who were segmented as having either pro-self, average, or sustainable motives; they found no matching effect. Graham and Abrahamse (2017) matched intervention messages encouraging individuals to eat less meat to participants' values (self-transcendence or self-enhancement); they found no matching effect. Similarly, Schnabelrauch Arndt (2016) found no matching effects for persuasive messages targeting self-schemas, egoistic/altruistic orientations, and values.

However, Allen and Baines (2002) found a type of matching effect related to enduring individual differences in social dominance orientation. Participants who were low in social dominance orientation and who read mismatched messages about meat consumption being related to hierarchy and dominance liked meat less and thought meat was worse than participants who were in the control condition; there were no significant differences in intention to eat meat in the future or actual dietary changes three weeks out. Thus, this intervention had qualified success and more generally matching studies have not been successfully leveraged in this domain. Lacroix and Gifford (2020) found that persuasive messages matched to the individual's meat-eater profile reduced people's diet-related carbon dioxide emissions over 28 days. This highlights the importance of matching the behavioral intentions of meat eaters.

### 1.5. Limitations of previous approaches

Previous conceptualizations of vegetarian motives and previous attempts at motivation-based dietary interventions both have notable weaknesses. The UMVI advances the study of vegetarian motives in two important ways. First, it is a continuous approach to motivation, rather than categorical, allowing for individuals to simultaneously fall into multiple motivational categories (Rosenfeld & Burrow, 2017a). Second, the UMVI is a goal-oriented framework, one that is theory-driven rather than a bottom-up assessment of people's self-professed motives (Rosenfeld & Burrow, 2017a), thereby addressing the shortcomings of many earlier motivational frameworks (see review above).

However, the motivations presented in the UMVI also have their own shortcomings. One of the main postulations of the UMVI is that animal, environmental, and health motives can be construed using broader motivational categories. But, the items used in developing Rosenfeld and Burrow's (2018) measure do not include any reference to specific animal welfare, environmental, or health motives. Instead, they are relatively vague (e.g., "I feel that I have a moral obligation to follow my dietary patterns"), which disregards the fact that individuals overwhelmingly consider specific animal, environmental, or health benefits when describing their own dietary choices (Fox & Ward, 2008a; Hopwood et al., 2020; Rosenfeld, 2018; Ruby, 2012).

Given that factor-analytic solutions are necessarily dependent on the items used in the analyses (Flake et al., 2017), Rosenfeld and Burrow's (2018) exclusion of items specifically about these traditional conceptualizations of motives makes suspect their claim that higher-order motivations are superior. In order to sufficiently test this claim,

items with prosocial, personal, and moral motives specifically framed within animal welfare, environmental, and health motivations need to be included in the factor-analytic procedure.

Another recent measure of vegetarian motives has similar shortcomings. Hopwood, Bleidorn, Schwaba, and Chen (2020) created the Vegetarian Motives Inventory (VEMI), which subsumes three main motives: health, environment, and animal rights. However, the items included in the development of this measure are all consistent with the assumption that health motives are self-focused and animal rights and environmental motives are other-focused. Therefore, it would be impossible for the factor-analytic solution to return the type of higher-order categories proposed by Rosenfeld and Burrow (2017b).

If Hopwood and colleagues (2020) had included prosocial, personal, and moral components for their three proposed motives it would have been a much stronger test of their conceptual framework; as is, it does little to expand beyond the qualitative, bottom-up approaches that have been utilized for decades to garner understanding of vegetarian motivations. These have been informative up to this point, but stronger tests are required in order to create rigorous psychometric measures of motives.

Additionally, the motives conceptualized by Rosenfeld and Burrow (2017b, 2018) are potentially too narrow. Although their larger UMVI includes aspects of social identity, this component is not defined as a motive; including social affiliation as a motive might be another important way to understand eating behaviors (Plante et al., 2019).

With regards to previous intervention approaches, most of the successful interventions were related to either providing information or eliciting emotions associated with eating meat. Although some interventions have targeted the health and environmental benefits of reducing meat intake (Carfora et al., 2019), these authors made no attempt to match messages to the factors most important to participants. There has been very little success in interventions matched to characteristics of the *individual*. Only one intervention targeted the motivations for reducing meat consumption, and the authors did not use a previously validated measure of motives to segment participants (Verain et al., 2017). An intervention utilizing informational materials matched to the motives of the individual would fill this gap in the literature.

In summary, existing conceptualizations and measures of vegetarian motivations exist in two bubbles: those that rely too heavily on respondent-generated categorizations of motives (i.e., health, animal welfare, environmental) without empirically testing the self- and other-focuses of these motives, and those that rely too heavily on higher-order categorizations (i.e., prosocial, personal, moral) without directly incorporating the respondent-generated motives that social scientists have been compiling for decades. Additionally, no interventions have successfully or adequately leveraged these motives to encourage the reduction of meat consumption.

### 1.6. A potential solution: The functionalist approach

Although Rosenfeld and Burrow (2017b) acknowledge that two individuals might make the same dietary choices for different reasons (Sobal et al., 2014) and broadly conceptualize vegetarian motivations as goal-oriented drives, the UMVI is only loosely tied to self-determination theory (Rosenfeld & Burrow, 2017a). Self-determination theory

distinguishes between intrinsic and extrinsic motivations, and the need for competence and autonomy drive most intrinsic motivations (Deci & Ryan, 2000). Stronger ties to a theoretical motivational framework would allow us to better understand these dietary motives.

### *1.6.1. Understanding motivations*

Functionalist theory allows for the consideration of more domain-specific motivations. In essence, functionalists claim that people develop attitudes that facilitate their individual goals, that different people can have the same attitudes that serve different functions, and that an attitude can serve multiple functions in the same person (Carpenter et al., 2013; Katz et al., 1956; Smith et al., 1956) The functionalist approach has a crucial advantage over traditional persuasive approaches. Traditional approaches tend to focus on encouraging individuals to change their beliefs, based on the assumption that this will result in subsequent behavioral change, whereas the functionalist approach targets individuals' specific motivations with a clearer link to actual behavior.

Early functionalist researchers generally classified attitudes as serving one of five functions: utilitarian, social-adjustive, value-expressive, ego-defensive, and knowledge, although they contended that this was not an exhaustive list of motives (Carpenter et al., 2013; Katz, 1960; Smith et al., 1956). However, there is no widely used general measure of attitude functions. Herek (1987) argued that his items could be adapted to any context and several others have attempted to create a general measure (Franc & Brkljačić, 2006; Locander & Spivey, 1978), but each of these attempts has fallen short.

Perhaps for this reason, a functionalist approach to motivations has not yet been widely adopted across areas of psychological study. It has been influential in the study of

attitudes and volunteer motives, but the motives in this theoretical framework are typically context-specific. Although some context-specific functional measures have been developed, such as the Volunteer Functions Inventory (VFI), this is one of the few examples of the successful implementation of this functionalist framework (Clary et al., 1998). Thus, applying a functionalist framework to vegetarian motives involves starting with the motives that were identified from bottom-up approaches.

### *1.6.2. Designing interventions*

Beyond aiding in the conceptualization of the motivational structure behind behaviors, the functionalist approach is particularly useful in targeting interventions. Snyder and DeBono (1985) were among the first to advocate for matching a message to characteristics of the targeted individual. They found that high self-monitors responded more to advertisements emphasizing the social image of the product and low self-monitors favored advertisements emphasizing the quality of the product (Snyder & DeBono, 1985).

There is a large body of research in which messages intended to encourage volunteering are matched to individual motivations (Clary et al., 1994, 1998). Further, when individuals' motivations match multiple aspects of the organization they volunteer with, their satisfaction and intentions to remain at the same volunteer organization increase (Stukas et al., 2009). The VFI has also been modified to facilitate matching paradigms in specific volunteering contexts (e.g., Stefan T. Güntert & Wehner, 2015) and financial donations (Johnson & Snyder, 2020).

Additionally, because morality is highly central to individuals' worldviews and self-concepts (Feinberg & Willer, 2015; Haidt & Graham, 2007), persuasive messages

are commonly matched to morals closely tied to the political orientation of the individual; this approach assumes that compared to liberals, conservatives are motivated more by purity, authority, and loyalty, whereas compared to conservatives, liberals are motivated more by protection from harm and fairness. Feinberg and Willer (2015) found that matching the framing of political issues to the morality of either conservatives or liberals led to increased endorsement of political policies that the recipients previously opposed. Contentious issues such as same-sex marriage and making English the official language of the United States were used in this study, demonstrating that even firmly held beliefs can be shifted (at least for a while) under moral reframing (Feinberg & Willer, 2015).

Moral framing has also been successfully used to change environmental attitudes and behaviors. Feinberg and Willer (2013) found that reframing congruent with political attitudes shifted the environmental attitudes of conservatives and led to increased support of pro-environmental legislation. Furthermore, Kidwell, Farmer, and Hardesty (2013) found that framing pro-environmental arguments in terms of loyalty, authority, and purity (the moral foundations most frequently endorsed by political conservatives) led to increased recycling. Scharmer and Snyder (under review) also found that matching persuasive pro-environmental messages encouraging individuals to reduce their meat consumption to an individual's political orientation led people to select fewer meals with meat in the following week in a hypothetical meal plan. Applying this type of intervention to use vegetarian motivation to reduce meat consumption requires only a slight extension.

### 1.7. The present line of work

In this dissertation, my goals were to use functionalist theory to, (1) develop a conceptualization of motives to follow a plant-based, (2) create a psychometrically validated instrument with which to measure these motives, (3) expand these constructs to encapsulate omnivores' motives for potentially reducing their meat consumption, and (4) design a psychological intervention aimed at decreasing omnivores' meat consumption through functional message matching.

The measure-development portion of this project occurred in three steps. First, I presented potential items related to vegetarian motives to a sample of individuals who have been following a vegetarian or vegan diet for at least 18 months to determine the factor structure of these dietary motivations. Unlike previous measures, these items can be categorized in two different ways. In line with previous research, there are items to relate to environmental, animal welfare, and health motivations. Additionally, in line with the functional framework and the functions identified in Clary and colleagues' (1998) conceptualization of volunteer motives, items were also written to relate to protective, value expressive, social, understanding, esteem-enhancement, instrumental, and personal experience motives.

In addition to capturing traditional functionalist motives, I also aimed to preserve the distinctions captured in other research on why people reduce their meat consumption. For most of the functionalist motives I included items that were related to the environment, animal welfare, and health, setting this new measure apart from other measures of vegetarian or vegan motives that either construe health motives as pro-self and environmental and animal welfare motives as prosocial (Hopwood et al., 2020) or

that do not specifically include health, animal welfare, and environmental motives in the motivational framework (Rosenfeld & Burrow, 2018). This wider range of items is consistent with other existing measures of broader eating motivations (Arbit et al., 2017; Sproesser et al., 2018).

Second, I confirmed the factor structure on the same type of sample: people who have followed a vegetarian or vegan diet for at least 18 months. Third, I confirmed that the same factor structure applies to individuals who do not yet follow a vegetarian or vegan diet, both in a sample from the United States and an international sample. This is a crucial step, as interventions to encourage the reduction of meat consumption are only useful on populations that consume some meat. Multiple samples that yield responses with the same factor structure indicate that intervention materials can be created and matched to individuals based on these motives.

After creating and validating the measure, I moved onto the intervention portion of the project. The intervention uses a message-matching design, a widely used technique in which features of a persuasive message are matched to individuals' motives. In these interventions, persuasive messages incorporate either a matched argument (i.e., consistent with a motivation that is important to an individual) or a mismatched argument (i.e., consistent with a motivation that is not important to an individual) or a no message control. In this study, participants will complete the aforementioned measure of motives, read a brief persuasive message related to one of the motives (or a no message in the control condition), and answer items related to their intentions to reduce their meat consumption, attitudes towards meat, and select a meal from a menu. Greater intentions

to reduce meat consumption, more negative attitudes towards meat, and selecting meals containing no meat products are considered pro-meat reduction outcomes.

I have three primary hypotheses related to this intervention. First, individuals with higher scores on my novel measures of motives will have more pro-meat reduction outcomes (i.e., a main effect for motives). Second, participants who read a message (compared to the no-message control) will have more pro-meat reduction outcomes (i.e., a main effect for message condition). Third, there will be a matching effect, such that participants who score high on a given motive (compared to participants who score low on the same motive) will have more pro-meat reduction outcomes after reading an argument that targets that motive (i.e., an interaction effect).

I also examine a few secondary hypotheses related to the reliability of this new measure of motives. First, I test the correlation between this measure and a single-item categorial motive item. Second, I test whether my measure predicts willingness to reduce meat consumption better than does Rosenfeld and Burrow's (2018) measure of dietarian identity. To test both of these I will examine the magnitude of correlations.

This line of research is generative because it both applies the robust functionalist theoretical framework to the impactful domain of dietary change and because extending functionalism to the domain of dietary change will be a tough test of this approach; if this approach can be successfully used in such a challenging area of behavioral change it will bolster the utility of functionalism.

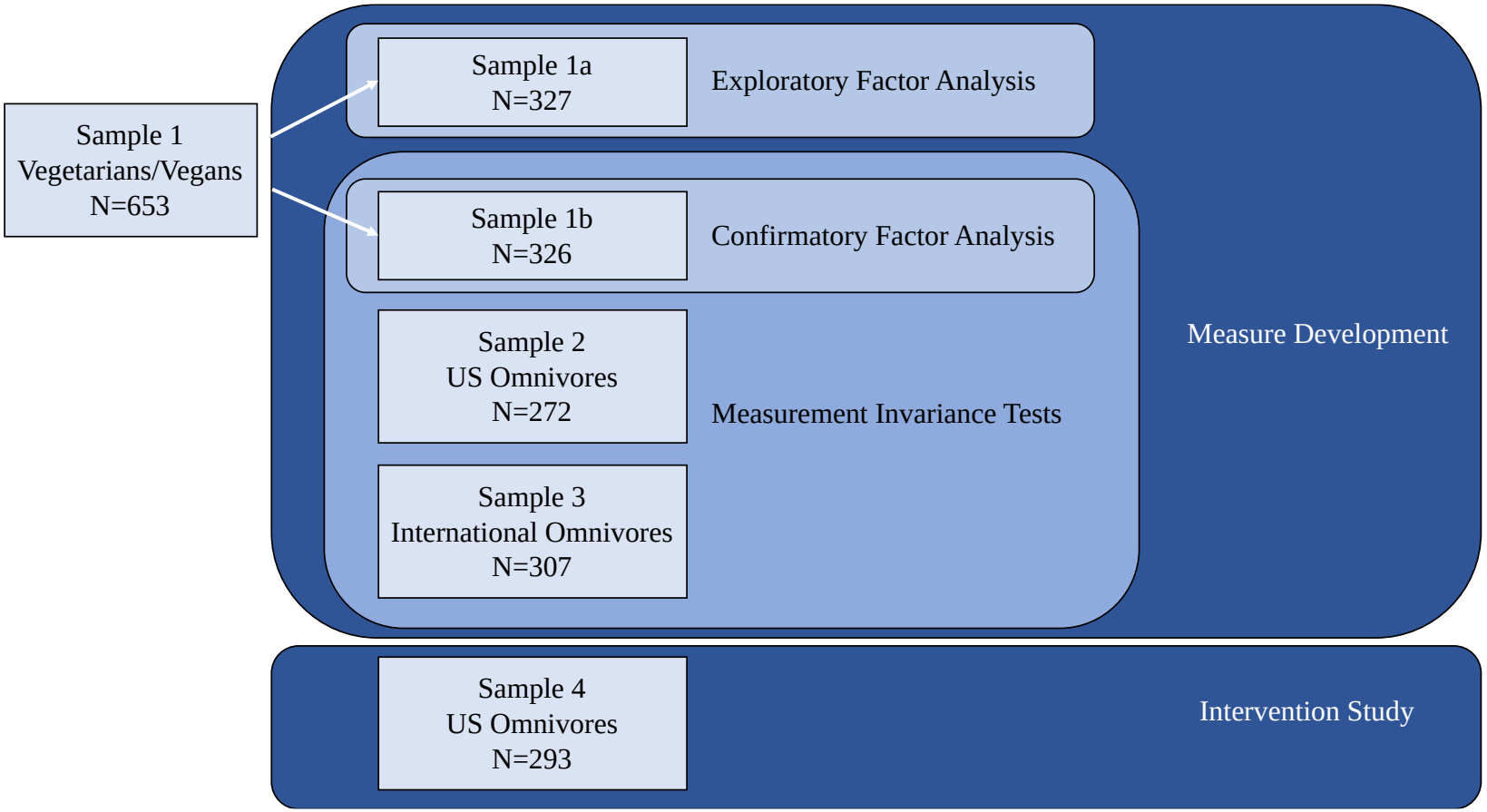
# 2. Measure Development and Validation

## 2.1. Method

### *2.1.1. Participants*

To create and validate a new measure of motivations to follow a plant-based diet, I collected data from three distinct samples (see Figure 1). First, I collected data from people who had been following a vegetarian or vegan diet for at least 18 months; I chose this timeframe to ensure that participants had somewhat crystalized motives and had not just adopted a plant-based diet. Second, I recruited participants who live in the United States who had not followed a meat-limiting diet (i.e., pescatarian, vegetarian, vegan) in the past 18-months. Third, I collected data from a similar non-meat-limiting sample, none of whom reside in the United States, and who speak languages other than English as their first language.

**Figure 1.** Diagram of samples and analyses



***2.1.1.1. Sample 1.*** I recruited 863 vegetarians and vegans from 18 Facebook groups (see Appendix A) for sample 1. This provided for over 300 individuals in each set of analyses (after excluding participants who did not complete the measure), which exceeds the minimum criteria for factor analysis (Mundfrom et al., 2005). Traditionally, vegetarian and vegan populations are somewhat difficult to access, and some studies have relied on imperfect recruitment methods such as snowball sampling (Fessler & Navarrete, 2003; Kerschke-Risch, 2015); recruiting through Facebook groups allows me to easily access this sample with no cost. Inclusion criteria required that participants had been vegetarian or vegan for at least 18 months, were at least 18 years old, and were fluent in English. They were not compensated for their participation in this study. I removed participants who did not complete all of the proposed motive items, resulting in 653 participants in the final sample; 327 participants were included in the exploratory factor analysis (Sample 1a) and 326 were included in the confirmatory factor analysis and measurement invariance tests (Sample 1b).

The sample was 81.6% female ($n$ = 533); 87.4% ($n$ = 571) identified as White or Caucasian, 0.8% ($n$ = 5) identified as Black or African-American, 3.2% ($n$ = 21) identified as Asian or Asian-American, 3.8% ($n$ = 25) identified as Hispanic or Latin-American, 0.8% ($n$ = 5) identified as Native American, and 1.7% ($n$ = 11) identified as Middle-Eastern. The average age of participants was 37.7 years old. Additionally, based on a seven-point scale of political ideology (1 = "extremely liberal," 7 = "extremely conservative"), participants tended to be much more liberal ($M$ = 2.67).

***2.1.1.2. Sample 2.*** I recruited 308 participants from Prolific, an online data-collection platform, for Sample 2. I excluded 36 participants who did not meet the

inclusion criteria of (1) not currently following a pescatarian, vegetarian, or vegan diet, or (2) not having followed a meat-limiting diet in the past 18 months; the sample used in analyses had 272 individuals. Participants in this sample were required to reside in the United States, and this was criterion was enforced through a built-in feature in Prolific; respondents were paid $1.25 for their participation in the study.

The sample was 57.7% female (*n* = 157); 68.4% (*n* = 186) identified as White or Caucasian, 5.9% (*n* = 16) identified as Black or African-American, 15.8% (*n* = 43) identified as Asian or Asian-American, 8.8% (*n* = 24) identified as Hispanic or Latin-American, 1.5% (*n* = 4) identified as Native American, and 1.1% (*n* = 3) identified as Middle-Eastern. The average age of participants was 32.6 years old and based on a seven-point scale of political orientation (1 = "extremely liberal," 7 = "extremely conservative"), participants tended to be more liberal (*M* = 2.91).

***2.1.1.3. Sample 3.*** The third sample used in the measure validation step was also recruited through Prolific, but without the filter requiring participants to reside in the United States. Therefore, this sample is composed predominantly of international participants, some of whom do not speak English as their first language. I recruited 369 participants who were paid $1.25, and 62 were excluded because they did not meet the inclusion criteria (same as Sample 2), resulting in a final sample of 307 participants.

The sample was 40.7% female (*n* = 125); 82.4% (*n* = 253) identified as White or Caucasian, 1.6% (*n* = 5) identified as Black, 2.6% (*n* = 8) identified as Asian, 10.7% (*n* = 33) identified as Hispanic or Latin-American, and 1% (*n* = 3) identified as Middle Eastern. The average age of participants was 26.4 years old and based on a seven-point scale of political orientation (1 = "extremely liberal," 7 = "extremely conservative"),

participants tended to be slightly more liberal ($M$ = 3.32). Among the participants who reported their first language, only 15.3% ($n$ = 29) reported their first language was English, 20.6% ($n$ = 39) reported Polish, 18% ($n$ = 34) reported Portuguese, 13.2% ($n$ = 25) reported Spanish, 9.5% ($n$ = 18) reported Italian, and 6.9% ($n$ = 13) reported Greek. This language-diverse group, all of whom also read English, allows me to test the performance of my measure on individuals who have English as a second language, which makes the measure generalizable to a much wider population.

Additionally, this sample consisted of participants of diverse nationalities. Of the participants who reported their nationality, 22.4% ($n$ = 68) reported Poland as their nation of origin, 22.1% ($n$ = 67) reported Portugal, 8.6% ($n$ = 26) reported Italy, 7.9% ($n$ = 24) reported the United Kingdom, 6.3% ($n$ = 19) reported Greece, 6.3% ($n$ = 19) reported Mexico, and 5.9% ($n$ = 18) reported Spain. This international sample allows me to test this measure on a sample of individuals outside of the United States.

### *2.1.2. Materials and Procedure*

***2.1.2.1. Sample 1.*** Participants completed three series of questions about their diet and motivations. First, they specified the types of food that they consider to be a regular and acceptable part of their diet. Second, they completed the 62 candidate items written by the author about vegetarian motives. All responses were on a five-point unipolar Likert scale ranging from “not at all true” to “extremely true.” Third, they answered a few items about their diet, including how long they had followed a plant-based diet and their self-classified motivations (e.g., improved health, animal welfare; see Appendix B).

Participants were directed to a Qualtrics survey through a post in one of 25 Facebook groups (see Appendix A). After answering screening questions and consenting

to participate in the study, they completed blocks of questions related to diet specification, the potential items for the new measure, diet history and self-professed motives, and demographics. Finally, they were debriefed about the purpose of the study.

***2.1.2.2. Samples 2 and 3.*** Participants from Samples 2 and 3 followed the same procedure. Before entering the study, participants completed a brief screener. People who had followed a pescatarian, vegetarian, or vegan diet (i.e., attempted to limit their meat consumption) during the past 18-months were allowed to participate in this study and compensated, but were not included in the analyses.

Following the screener, they completed three sets of questions. First, they completed the 62-item measure of vegetarian motives (see Appendix B). Second, they indicated reasons they might be interested in reducing their meat consumption and ranking the potential reasons; participants also specified which types of animal products are currently a regular and acceptable part of their diet and reported whether they have considered adopting a pescatarian, vegetarian, or vegan diet in the past. Participants were directed to the Qualtrics survey through a link on Prolific.

## 2.2. Results

The data from samples 1, 2, and 3 were used in the measure validation portion of this study. Sample 1 was randomly split in half and half of the sample was used for the exploratory factor analysis (Sample 1a); the other half of the sample was used for the confirmatory factor analysis and tests of measurement invariance (Sample 1b). Samples 2 and 3 were also used in the tests of measurement invariance. See Figure 1 for a visual depiction.

### *2.2.1. Exploratory Factor Analysis*

In order to determine the number of factors to extract, I conducted a parallel analysis and examined the scree plot on Sample 1a. My visual inspection of the scree plot suggests extracting between two and eight factors, and the parallel analysis suggestions that there were six factors. As a result, I examined the factor loading from the exploratory factor analysis (EFA) for two-, three-, four-, five-, six-, seven-, and eight-factor solutions using an oblimin rotation. The oblimin rotation is preferred because it allows for the factors to be correlated with one another. However, the eight-factor solution did not converge and will thus be disregarded.

Using a factor-loading cutoff of 0.4, the four-factor solution produced minimal cross-loading between items as well as an interpretable solution (see Table 1). Five-, six-, and seven-factor solutions were not preferred because they resulted in very little incremental variance explained. The four-factor solution explained 44.6% of the variance and adding a fifth (and subsequent) factors only explained an additional 3% of the variance. Additionally, fifth (and subsequent) factors resulted in an insufficient number of primary loadings, making the solutions difficult to interpret.

**Table 1.** Factor loading for full measure with a four-factor solution

| Item | Animal | Env. | Health | Social |
|---|---|---|---|---|
| I eat a plant-based diet because it… | | | | |
| Helps me feel less guilty about the cruel treatment of animals (protective/animal) | **0.573** | 0.007 | 0.054 | -0.006 |
| Helps me avoid becoming sick (protective/health) | 0.012 | -0.092 | **0.818** | 0.01 |
| Makes me feel less guilty about the negative impact my actions have on the environment (protective/environment) | 0.154 | **0.464** | 0.02 | 0.046 |
| Allows me to do my part to prevent animals from suffering (protective/animal) | **0.845** | -0.059 | 0.029 | -0.029 |
| Is one thing I can do to prevent climate change (protective/environment) | 0.06 | **0.71** | 0.019 | -0.035 |
| **Helps to lower my risk of contracting a serious disease (protective/health)** | -0.048 | 0.019 | **0.839** | -0.031 |
| Allows me to express my values about my health (values/health) | 0.041 | -0.033 | **0.767** | 0.048 |
| Is consistent with my opinions about animal welfare (values/animal) | **0.869** | 0.006 | -0.074 | -0.022 |
| **Is consistent with my other opinions about environmentalism (values/environment)** | 0.079 | **0.758** | -0.034 | -0.005 |
| **Allows me to connect with other people (social)** | 0.072 | 0.023 | 0.141 | **0.583** |
| **Makes me feel like I'm part of a larger community (social)** | 0.15 | 0.014 | 0.2 | **0.472** |
| Allows me to spend more time with people who are important to me (social) | -0.042 | -0.069 | 0.353 | 0.353 |
| Helps me learn more about the environmental impact of eating animal products (understanding/environment) | 0.181 | **0.616** | 0.094 | 0.084 |
| **Helps me understand the way food is connected to environmental problems (understanding/environment)** | 0.003 | **0.768** | 0.104 | 0.081 |
| **Allows me to understand the connection between what I eat and how I feel (understanding/health)** | 0.034 | 0.102 | **0.744** | -0.045 |
| **Allows me to learn how to eat in a way that is sustainable for the Earth (understanding/environment)** | -0.062 | **0.757** | 0.133 | -0.003 |
| Helps me understand the way animals are involved in our food system (understanding/animal) | **0.443** | 0.302 | 0.198 | 0.004 |
| Makes me feel strong (esteem) | 0.088 | -0.094 | **0.723** | 0.128 |
| Helps me feel like I am advancing animal welfare (esteem/animal) | **0.808** | -0.028 | 0.062 | 0.006 |
| Helps me feel like I'm doing something important (esteem) | **0.43** | 0.131 | 0.191 | 0.213 |
| Makes me feel like I am doing enough to address animal cruelty (esteem/animal) | **0.405** | 0.022 | 0.087 | 0.082 |
| Makes me feel like I am doing enough to address environmental problems (esteem/environmental) | 0.134 | 0.22 | 0.118 | 0.197 |
| **Makes me feel like my body is working as it should (instrumental/health)** | 0.012 | -0.035 | **0.864** | -0.023 |
| **Will help me to live longer (instrumental/health)** | -0.018 | -0.094 | **0.849** | 0.048 |
| **Prevents animal suffering (instrumental/animal)** | **0.763** | -0.031 | 0.008 | -0.066 |
| I eat a plant-based diet because… | | | | |
| I can avoid developing severe diseases as I age (protective/health) | -0.061 | 0.001 | **0.832** | -0.028 |
| It prevents me from gaining weight (protective/health) | 0.078 | -0.131 | **0.506** | 0.087 |
| It helps me avoid feeling guilty after I eat meat (protective) | 0.317 | 0.185 | 0.019 | 0.023 |
| I want to live a healthy lifestyle and spend time with people who are important to me (values/health) | -0.141 | 0.039 | **0.668** | 0.171 |
| **I feel compassion towards animals used in food production (values/animal)** | **0.794** | -0.063 | 0.006 | -0.047 |

| | | | | |
|---|---|---|---|---|
| **It is important to have a healthy diet (values/health)** | -0.117 | 0.115 | **0.714** | -0.034 |
| It allows me to express values that are important to me (values) | **0.53** | 0.107 | 0.047 | 0.111 |
| **I want to express my values about animal welfare (values/animal)** | **0.791** | 0.074 | -0.107 | 0.032 |
| It is consistent with other health behaviors that are important to me (values/health) | -0.106 | 0.146 | **0.716** | -0.051 |
| **I believe it is wrong to kill another living being when I have other options for food (values/animal)** | **0.706** | 0.032 | -0.105 | 0.031 |
| **My friends eat a plant-based diet (social)** | -0.02 | -0.004 | -0.114 | **0.676** |
| **People in my community value eating a plant-based diet (social)** | -0.054 | 0.11 | -0.042 | **0.624** |
| I'm a part of groups that value eating a plant-based diet (social) | 0.156 | -0.064 | 0.136 | **0.525** |
| The people I most often eat meals with follow a plant-based diet (social) | -0.058 | -0.027 | -0.093 | **0.581** |
| **Important people in my life think eating a plant-based diet is important (social)** | -0.102 | 0.106 | -0.025 | **0.604** |
| It allows me to learn more about animal welfare (understanding/animal) | **0.511** | 0.223 | 0.139 | 0.087 |
| It helps me to learn about my own health (understanding/health) | -0.02 | 0.117 | **0.776** | -0.04 |
| It makes me feel more connected to my food (understanding) | 0.094 | 0.23 | **0.498** | 0.006 |
| I want to gain a better understanding of where my food comes from (understanding) | 0.097 | **0.406** | 0.274 | 0.037 |
| It makes me feel good about myself (esteem) | 0.051 | 0.127 | **0.473** | 0.184 |
| It makes me feel good about my relationship with food (esteem) | 0.145 | 0.114 | **0.526** | -0.005 |
| It makes me feel better about my health (esteem/health) | -0.037 | 0.038 | **0.872** | -0.063 |
| It makes me happy (esteem) | 0.207 | 0.116 | 0.397 | 0.097 |
| Following this diet will help me lose weight (instrumental/health) | 0.054 | -0.147 | **0.539** | 0.123 |
| I want to save money on food (instrumental) | -0.002 | 0.091 | 0.307 | 0.127 |
| I want to save money on healthcare (instrumental/health) | -0.035 | 0.002 | **0.582** | 0.155 |
| **I want to lessen my environmental impact (instrumental/environment)** | -0.007 | **0.871** | -0.013 | -0.047 |
| It is a way of accomplishing one of my goals (instrumental) | 0.093 | 0.095 | **0.463** | -0.023 |
| It is easier for me to eat a plant-based diet than to eat animal products (instrumental) | 0.064 | 0.001 | 0.192 | 0.24 |
| My family members have experienced poor health because of their consumption of animal products (personal experience/health) | 0.059 | 0.014 | **0.583** | -0.018 |
| I've seen the ways that plant-based diet has benefited people that I know (personal experience) | -0.114 | 0.108 | 0.329 | 0.382 |
| **I have seen animals suffering in order to produce food (personal experience/animal)** | **0.718** | 0.016 | -0.028 | -0.011 |
| I have seen the negative effects of factory farming (personal experience) | **0.567** | 0.211 | -0.071 | 0.031 |
| Animal products have negatively impacted my health (personal experience/health) | 0.093 | -0.037 | **0.654** | -0.003 |
| I have seen the negative environmental consequences related to animal products (personal experience/environment) | 0.144 | **0.665** | -0.044 | 0.109 |
| **I expect that I will be negatively impacted by climate change if we do nothing (personal experience/environment)** | -0.051 | **0.813** | -0.113 | 0.035 |
| I have seen the poor conditions of factory farms (personal experience/animal) | **0.615** | 0.108 | -0.059 | 0.028 |

*Note.* Loadings greater than 0.4 are bolded; items retained in the 20-item version are bolded.

Next, I dropped eight items without strong loadings on any of the four factors and re-ran the EFA. I iteratively selected the top 7 items from each factor (28 total) and then the top 5 items from each factor (20 total) to produce the final 20-item measure. Factor loading for the 20-item measure are depicted in Table 2; this factor solution explained 55.9% of the variance.

**Table 2.** Factor loadings for the 20-item measure

| Item | Animal | Env. | Health | Social |
|---|---|---|---|---|
| I eat a plant-based diet because it... | | | | |
| Helps to lower my risk of contracting a serious disease (protective/health) | -0.03 | 0.032 | **0.841** | -0.022 |
| Is consistent with my other opinions about environmentalism (values/environment) | 0.111 | **0.741** | -0.011 | 0.011 |
| Allows me to connect with other people (social) | 0.078 | -0.045 | 0.193 | **0.629** |
| Makes me feel like I'm part of a larger community (social) | 0.134 | -0.036 | 0.261 | **0.501** |
| Helps me understand the way food is connected to environmental problems (understanding/environment) | 0.019 | **0.729** | 0.122 | 0.101 |
| Allows me to understand the connection between what I eat and how I feel (understanding/health) | 0.027 | 0.126 | **0.704** | -0.01 |
| Allows me to learn how to eat in a way that is sustainable for the Earth (understanding/environment) | -0.043 | **0.721** | 0.156 | 0.007 |
| Makes me feel like my body is working as it should (instrumental/health) | 0.014 | -0.023 | **0.84** | 0.019 |
| Will help me to live longer (instrumental/health) | -0.002 | -0.069 | **0.859** | 0.043 |
| Prevents animal suffering (instrumental/animal) | **0.715** | -0.002 | 0.028 | -0.023 |
| I eat a plant-based diet because... | | | | |
| I feel compassion towards animals used in food production (values/animal) | **0.819** | -0.047 | 0.053 | -0.034 |
| It is important to have a healthy diet (values/health) | -0.078 | 0.12 | **0.674** | -0.01 |
| I want to express my values about animal welfare (values/animal) | **0.781** | 0.064 | -0.046 | 0.043 |
| I believe it is wrong to kill another living being when I have other options for food (values/animal) | **0.777** | 0.042 | -0.076 | 0.02 |
| My friends eat a plant-based diet (social) | -0.02 | -0.014 | -0.121 | **0.691** |
| People in my community value eating a plant-based diet (social) | -0.056 | 0.097 | -0.071 | **0.671** |
| Important people in my life think eating a plant-based diet is important (social) | -0.087 | 0.13 | 0.006 | **0.488** |
| I want to lessen my environmental impact (instrumental/environment) | 0.021 | **0.892** | -0.021 | -0.045 |
| I have seen animals suffering in order to produce food (personal experience/animal) | **0.709** | 0.012 | 0.001 | -0.016 |
| I expect that I will be negatively impacted by climate change if we do nothing (personal experience/environment) | -0.012 | **0.8** | -0.102 | 0.02 |

*Note*: Factor loadings over 0.4 are bolded

The four-factor solution can be interpreted as having subscales of health, animal-welfare, environmental, and social motives. All subscales had acceptable Cronbach's alpha values. Alpha could not be increased by dropping additional items on any of the subscales. The correlations between factors and Cronbach's alphas are in Table 3.

**Table 3.** Correlations between factors in Study 1

| | Mean | SD | Animal welfare | Environmental | Health | Social |
|---|---|---|---|---|---|---|
| Animal welfare | 21.92 | 4.17 | 0.87 | | | |
| Environmental | 20.76 | 4.52 | 0.40*** | 0.90 | | |
| Health | 18.58 | 5.23 | -0.06 | 0.34*** | 0.90 | |
| Social | 11.37 | 4.23 | 0.13 | 0.35*** | 0.38*** | 0.75 |

*Note:* Cronbach's alpha on diagonal; * $p<0.05$. *** $p<0.001$

### *2.2.2. Confirmatory Factor Analysis*

I used the lavaan package in R (Rossell, 2012) to conduct a confirmatory factor analysis (CFA) on sample 1b. I tested the same four-factor structure identified in the exploratory factor analysis, allowing all four factors to be correlated with one another. Variances and covariances for each of the variables are presented in Table 4. The comparative fit index (CFI) = 0.915, the Tucker Lewis fit index (TLI) = 0.902, and the RMSEA = 0.074, each consistent with acceptable model fit. Standardized and unstandardized parameter estimates are provided in Table 5.

**Table 4.** Variance-covariance matrix for confirmatory factor analysis

| | h1 | h2 | h3 | h4 | h5 | a1 | a2 | a3 | a4 | a5 | e1 | e2 | e3 | e4 | e5 | s1 | s2 | s3 | s4 | s5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| h1 | 1.763 | | | | | | | | | | | | | | | | | | | |
| h2 | .839 | 1.683 | | | | | | | | | | | | | | | | | | |
| h3 | 1.098 | 1.046 | 1.574 | | | | | | | | | | | | | | | | | |
| h4 | 1.232 | .887 | 1.105 | 1.608 | | | | | | | | | | | | | | | | |
| h5 | .728 | .759 | .809 | .728 | 1.142 | | | | | | | | | | | | | | | |
| a1 | .076 | .009 | -.039 | .034 | -.159 | 1.090 | | | | | | | | | | | | | | |
| a2 | -.164 | -.021 | -.174 | -.173 | -.188 | .556 | .919 | | | | | | | | | | | | | |
| a3 | -.176 | .043 | -.137 | -.183 | -.214 | .699 | .838 | 1.396 | | | | | | | | | | | | |
| a4 | -.197 | -.044 | -.116 | -.194 | -.152 | .551 | .689 | .770 | .956 | | | | | | | | | | | |
| a5 | .009 | .219 | -.040 | -.021 | -.077 | .617 | .688 | .781 | .622 | 1.265 | | | | | | | | | | |
| e1 | .239 | .347 | .236 | .193 | .153 | .387 | .369 | .601 | .316 | .461 | 1.168 | | | | | | | | | |
| e2 | .358 | .615 | .462 | .324 | .247 | .233 | .186 | .435 | .144 | .426 | .803 | 1.373 | | | | | | | | |
| e3 | .406 | .512 | .403 | .384 | .261 | .249 | .180 | .373 | .149 | .324 | .745 | .789 | 1.058 | | | | | | | |
| e4 | .226 | .270 | .199 | .144 | .189 | .307 | .304 | .462 | .274 | .365 | .793 | .653 | .626 | .973 | | | | | | |
| e5 | .176 | .352 | .177 | .120 | .192 | .229 | .231 | .422 | .230 | .404 | .722 | .663 | .607 | .684 | 1.350 | | | | | |
| s1 | .394 | .660 | .533 | .459 | .304 | .131 | .076 | .193 | .073 | .228 | .383 | .598 | .441 | .315 | .334 | 1.525 | | | | |
| s2 | .442 | .722 | .548 | .490 | .379 | .238 | .223 | .425 | .194 | .394 | .611 | .773 | .620 | .460 | .508 | 1.129 | 1.908 | | | |
| s3 | .164 | .213 | .177 | .209 | .195 | -.004 | .088 | .111 | .003 | .121 | .166 | .319 | .223 | .193 | .284 | .468 | .570 | 1.112 | | |
| s4 | .213 | .306 | .256 | .277 | .237 | .005 | .021 | .111 | -.003 | .142 | .171 | .282 | .184 | .085 | .128 | .477 | .519 | .585 | 1.227 | |
| s5 | .483 | .371 | .417 | .405 | .314 | .116 | -.056 | .039 | .023 | .134 | .205 | .365 | .311 | .186 | .299 | .589 | .757 | .736 | .580 | 1.843 |

*Note:* h-health motive, a=animal welfare motive, e-environmental motive, s=social motive

**Table 5.** Confirmatory factor analysis parameter estimates

| Item | Subscale | $\beta$ | $b$ | $SE$ |
|---|---|---|---|---|
| Prevents animal suffering | animal | 0.661 | 1 | |
| It helps me avoid feeling guilty after I eat meat | animal | 0.879 | 1.222 | 0.091 |
| I want to express my values about animal welfare | animal | 0.844 | 1.445 | 0.111 |
| I believe it is wrong to kill another living being when I have other options for food | animal | 0.806 | 1.143 | 0.091 |
| I have seen animals suffering in order to produce food | animal | 0.721 | 1.175 | 0.103 |
| Is consistent with my other opinions about environmentalism | enviro | 0.871 | 1 | |
| Helps me understand the way food is connected to environmental problems | enviro | 0.747 | 0.929 | 0.059 |
| Allows me to learn how to eat in a way that is sustainable for the Earth | enviro | 0.785 | 0.857 | 0.050 |
| I want to lessen my environmental impact | enviro | 0.818 | 0.858 | 0.047 |
| I expect that I will be negatively impacted by climate change if we do nothing | enviro | 0.670 | 0.826 | 0.061 |
| Helps to lower my risk of contracting a serious disease | health | 0.787 | 1 | |
| Allows me to understand the connection between what I eat and how I feel | health | 0.709 | 0.879 | 0.066 |
| Makes me feel like my body is working as it should | health | 0.857 | 1.029 | 0.062 |
| Will help me to live longer | health | 0.825 | 1.001 | 0.063 |
| It is important to have a healthy diet | health | 0.692 | 0.708 | 0.055 |
| Allows me to connect with other people | social | 0.756 | 1 | |
| Makes me feel like I'm part of a larger community | social | 0.814 | 1.204 | 0.094 |
| My friends eat a plant-based diet | social | 0.553 | 0.624 | 0.068 |
| People in my community value eating a plant-based diet | social | 0.450 | 0.593 | 0.072 |
| Important people in my life think eating a plant-based diet is important | social | 0.549 | 0.798 | 0.088 |

### *2.2.3. Measurement Invariance Tests*

In this portion of the analyses, I tested the measurement invariance of the new measure of vegetarian motives, comparing vegetarian/vegan and omnivore samples. I used a multiple groups CFA. Participants from Sample 1b were the vegetarian/vegan sample, participants from Sample 2 were omnivores from the United States that presumably speak English as a first language, and participants from Sample 3 were omnivores from a general Prolific sample, the majority of which reported English as their second language. Tests of measurement invariance are hierarchical and typically utilize a chi-square test of goodness of fit. Insignificant changes in the chi-square test between nested models mean the invariance assumption holds (see Putnick et al., 2016 for a review). Again, I used the lavaan package in R for these analyses (Rossell, 2012).

First, I tested for configural invariance, that is, confirmation that the factor structure is the same for all three groups. This is the minimum condition required to use the measure in omnivore samples. I found acceptable fit measures for the multiple group model; the comparative fit index (CFI) = 0.921, the Tucker Lewis fit index (TLI) = 0.908, and the RMSEA = 0.077. Thus, I moved only the next test of metric invariance. All subsequent results for tests of measurement invariance are summarized in Table 6.

Metric (or weak) invariance assumes that the factor loadings are the same for all three groups. I did not find metric invariance between the three groups (see Table 6); freeing some of the loading to differ between groups did not result in partial metric invariance. Therefore, it is unwise to compare means on this measure between vegetarians and omnivores.

**Table 6.** Results of tests of measurement invariance

| Model | χ2 (df) | CFI | RMSEA (90% CI) | SRMR | Model comp | Δχ2 (Δdf) | ΔCFI | ΔRMSEA | ΔSRMR | Decision |
|---|---|---|---|---|---|---|---|---|---|---|
| *Three groups* | | | | | | | | | | |
| M1: Configural Invariance | 1362.315*** (492) | 0.921 | 0.077 (0.072, 0.082) | 0.060 | - | - | - | - | - | - |
| M2: Metric Invariance | 1451.143*** (524) | 0.916 | 0.077 (0.072, 0.082) | 0.067 | M1 | 88.829*** (32) | 0.005 | 0 | 0.007 | Reject |
| *Two groups (omnivores)* | | | | | | | | | | |
| M1: Configural Invariance | 905.021*** (328) | 0.924 | 0.079 (0.073, 0.085) | 0.056 | - | - | - | - | - | - |
| M2: Metric Invariance | 922.208*** (344) | 0.923 | 0.077 (0.071, 0.083) | 0.060 | M1 | 17.188 (16) | 0.001 | 0.002 | 0.004 | Accept |
| M3: Scalar Invariance | 975.387*** (360) | 0.919 | 0.078 (0.072, 0.083) | 0.061 | M2 | 53.179*** (16) | 0.004 | 0.001 | 0.001 | Reject |
| M3a: Partial Scalar Invariance | 941.994*** (357) | 0.923 | 0.076 (0.070, 0.082) | 0.060 | M2 | 19.786 (13) | 0 | 0.001 | 0 | Accept |
| M4: Residual Invariance | 971.603*** (377) | 0.921 | 0.074 (0.069, 0.080) | 0.060 | M3a | 29.609 (20) | 0.002 | 0.002 | 0 | Accept |

*Note:* Three groups N=906, Vegetarians/vegans N=327, US omnivores N=272, International omnivores N=307; Two groups (omnivores) N=579

*** $p < 0.001$

However, I also continued the tests of measurement invariance between the two omnivore samples (US and international). There were no significant differences between the configural model (same factor structure between groups) and the metric invariance model (same factor loadings between groups; see Table 6), which indicates that there is metric invariance between the two omnivore samples.

Next, I tested for scalar (or strong) invariance, that is, whether the intercepts are the same for the two omnivore samples. This is the minimum requirement to compare means across groups. The metric invariance and scalar invariance model were significantly different, indicating that there is not scalar invariance. However, after reviewing modification indices, I allowed three items[2] on the measure to have different intercepts between the two omnivore samples, and this model was not significantly worse than the metric invariance model; this indicates that we have partial scalar invariance (Table 6). Last, I tested for residual invariance (i.e., the residuals are equal in both groups) and found no significant differences between models, indicating that the groups do have residual invariance. As a result, should move forward with caution when interpreting group differences between US and international, English as a second language samples, particularly in the environmental and health subscales, which contain the invariant items.

### 2.3. Discussion

My goal in developing this measure was to use a functional approach to attitudes to better understand and quantify individuals' motivations for following a plant-based diet. In the item development phase, I carefully crafted items that varied on two

[2] Item 5 (environmental) from the first stem, items 9 and 24 (both health) from the second stem

dimensions: their relation to classic functional motives (e.g., understanding, value-expression, social) and their relation to vegetarian motives previously identified in qualitative studies (e.g., animal welfare, health). After conducting the exploratory factor analysis, it became clear that there were four important motives: animal welfare, environmental, health, and social. The animal welfare, environmental, and health motives all included items that represent a variety of classic function motives (e.g., health items reflected both "protection" and "understanding" motives). However, it was challenging to write social items that touched on animal welfare, environmental, or health motives as well, so those items did not overlap with the vegetarian motives identified in previous work. Notably, the social subscale has a much lower mean ($M$ = 11.37) than the other three motives (see Table 3). This likely means that, although it is a distinct class of motives, vegetarians and vegans are far less compelled to follow plant-based diets for social reasons compared to other motives.

The results of the confirmatory factor analysis verify the four-factor structure. After conducting the measurement invariance test, I concluded that the factor structure between vegetarians/vegans and omnivores is the same, but that the means of these groups should not be compared to one another. Additionally, omnivores in the United States and omnivores in international samples for whom English is not their first language respond to the items in similar ways. Although there is only partial strict invariance, it is safe to compare scores on across these type of samples on animal welfare and social subscales.

In these studies, I determined that a four-factor motive structure describes both (a) vegetarian's/vegan's motives for adhering to the current diet and (b) omnivore's motives

for considering reducing their meat consumption in the future. This measure builds on existing qualitative work in this area (e.g., Jabs et al., 1998; Ruby, 2012) and provides a theoretically grounded, psychometrically validated way to assess motives, which addresses weakness of previous dietary motive measures (see discussion of Rosenfeld & Burrow's (2018) measure above).

## 3. Intervention Study

The purpose of this study is to use the previously developed measure of vegetarian motives in an intervention designed to encourage individuals to reduce their meat consumption. This study employs a message-matching procedure in which individuals view a randomly assigned persuasive appeal related to one of the four previously identified motives or who were assigned to a control condition and received no message.

### 3.1. Pilot study

Before running the full intervention, I piloted the persuasive messages on a separate sample of 201 individuals recruited via Prolific, all of whom reside in the United States. I created one message for each of the four motives (identified by the data in earlier studies). These messages were each approximately 120 words in length, were framed to target one of four motives (animal welfare, environmental, health, or social), and encouraged individuals to reduce their meat consumption (see Appendix D for full messages). Participants were randomly assigned to read one of the experimental messages and answered several questions about their perceptions of the primary motives highlighted in the message, the overall point of the message, and the clarity of the message.

In the pilot study, I found that participants' ratings of the messages did not differ on items related to message clarity or ease of understanding, interest in the message, or comprehension of the message argument. Participants also were able to identify the correct benefit highlighted in each message (e.g., health, animal welfare, environmental, or social), although they were slightly worse at identifying the messages with social benefits.

In general, based on the pilot study, I concluded that the experimental manipulations were easy to comprehend and adequately appealed to the appropriate motivation and were appropriate to implement in the main intervention study.

## 3.2. Method

### *3.2.1. Participants*

I recruited 356 participants using Prolific. Participants all resided in the United States and in response to a screening question about dietary restrictions, they did not indicate that they followed a vegan or vegetarian diet. They first answered a brief screener, which ensured that they were not currently pescatarian, vegetarian, or vegan (or had been in the past 18 months) and were at least somewhat willing to reduce the amount of meat in their diet; all participants completed the study, but those who did not meet the preregistered inclusion criteria were excluded from analysis. Two hundred and ninety-three participants who met the inclusion criteria were used in the following analyses.

The sample was 56.7% female ($n$ = 166); 70.7% ($n$ = 206) identified as White or Caucasian, 6.1% ($n$ = 18) identified as Black or African-American, 15.7% ($n$ = 46) identified as Asian or Asian-American, 10.2% ($n$ = 30) identified as Hispanic or Latin-American, 1.0% ($n$ = 3) identified as Native American, and 1.4% ($n$ = 4) identified as

Middle-Eastern. The average age of participants was 34.9 years old. Additionally, based on a seven-point scale of political ideology (1 = "extremely liberal," 7 = "extremely conservative"), participants tended to be somewhat more liberal ($M$ = 2.88).

### *3.2.2. Materials and Procedure*

Before beginning the main study, participants answered three screening items. They reported whether they were currently following a pescatarian, vegetarian or vegan diet, whether they had followed a pescatarian, vegetarian, or vegan diet in the past two years, and how willing they were to reduce their current meat consumption. Individuals who were not currently and had not recently followed a meat-limiting diet and said they "might consider," "probably will consider," or "definitely will consider" reducing their current meat consumption were included in analyses.

In the main study, participants first answered the 20-item measure of vegetarian motives validated in my previous studies (see Appendix E); this scale produced four subscores, each with acceptable internal reliability (animal welfare $\alpha$ = 0.90, environmental $\alpha$ = 0.92, health $\alpha$ = 0.88, social $\alpha$ = 0.84). Next, participants were randomly assigned to one of the four message conditions or to a no-message control condition. Following the experimental manipulation, they answered a single item about their intentions to reduce their meat consumption, completed five semantic differentials about their attitudes towards meat ($\alpha$ = 0.94), and completed a menu task in which they imagined that they were ordering a meal. I counted the total number of items they chose containing meat and created a binary variable of meat/no meat to be used in the analyses. Intentions to reduce meat consumption was significantly correlated with the menu task such that people who said they were more likely to reduce their meat consumption were

also less likely to select a food item containing meat ($r$ = -0.225, $p$ < 0.001). Attitudes towards meat were not significantly correlated with the intentions measure ($r$ = -0.011, $p$ = 0.849) nor selecting a meal containing meat from the menu task ($r$ = -0.019, $p$ = 0.746)

Participants also answered two items about their categorical motivations for reducing their meat consumption and three motive subscales from Rosenfeld and Burrow's (2018) Dietarian Identity Questionnaire. There were six items related to prosocial motivation ($\alpha$ = 0.94), three items related to personal motivation ($\alpha$ = 0.82), and three items related to moral motivation ($\alpha$ = 0.92); all responses were made using a seven-point Likert scale ranging from "strongly disagree" to "strongly agree" and were summed for each subscale. The entirety of these measures can be found in Appendix F.

## 3.3. Results

### *3.3.1. Hypothesis 1*

In order to test Hypothesis 1, that each motive is related to greater intentions to reduce meat consumption, more negative attitudes towards meat, and eschewing meat products during the menu task, I examined the correlations between each motive and the dependent variables. All correlations between motives subscales and dependent variables appear in Table 7. Each of the four motives was significantly correlated (in the hypothesized direction) with the individual's intentions for reducing their meat consumption.[3] Additionally, in line with my hypotheses, the animal-welfare motive and the social motive were significantly negatively correlated with attitudes towards meat and

[3] After controlling for all other motives, the environmental motive ($\beta$ = 0.417, 95% CI [0.291, 0.544], $p$ < 0.001) and the health motive ($\beta$ = 0.200, 95% CI [0.087, 0.314], $p$ = 0.001) both significantly predicted the individual's intentions for reducing their meat consumption after controlling for the other motives; the animal welfare ($\beta$ = 0.070, 95% CI [-0.051, 0.189], $p$ = 0.256) and social motive ($\beta$ = -0.008, 95% CI [-0.121, 0.104], $p$= 0.884) did not.

selecting a meal containing a meat option.[4,5] Neither environmental nor health motives were significantly correlated with attitudes towards meat and selecting a meat option, contrary to hypotheses.

**Table 7.** Correlations between motive subscales and dependent variables.

| | Intentions | | Attitudes | | Meat selection | |
|---|---|---|---|---|---|---|
| | *r* | *p* | *r* | *p* | *r* | *p* |
| Animal motive | 0.387 | <0.001 | -0.136 | 0.393 | -0.125 | 0.033 |
| Env. motive | 0.549 | <0.001 | -0.050 | 0.016 | -0.079 | 0.178 |
| Health motive | 0.415 | <0.001 | -0.033 | 0.575 | 0.018 | 0.765 |
| Social motive | 0.295 | <0.001 | -0.141 | 0.016 | -0.124 | 0.035 |

*Note:* correlations with likelihood of reducing meat consumption and attitudes towards meat are Pearson correlation coefficients, correlations with selecting a meal containing meat are point-biserial.

Intentions = intentions to reduce meat consumption (higher values are more likely to reduce meat)
Attitudes = attitudes towards meat (higher values are more positive attitudes)
Meat selection = binary variable of selecting a dish containing meat or not (1=meat selected)

### *3.3.2. Hypothesis 2*

In order to test Hypothesis 2, that each persuasive message will be more effective than the no-message control condition in eliciting intentions to reduce meat consumption, negative attitudes towards meat, and abstaining from selecting meat products, I ran a one-way ANOVA on intentions to reduce meat consumption and attitudes towards meat and a chi-squared test of independence on the meat selection

[4] After controlling for all other motives, the social motive ($\beta$ = -0.139, 95% CI [-0.275, -0.003], $p$ = 0.0445) significantly predicts attitudes towards meat after controlling for the other motives and the animal welfare motive was marginally significant ($\beta$ = -0.141, 95% CI [-0.287, 0.004], $p$ = 0.057); the environmental motive ($\beta$ = 0.071, 95% CI [-0.082, 0.225], $p$ = 0.362) and health motive ($\beta$ = 0.049, 95% CI [-0.088, 0.186], $p$ = 0.484) were not significant.

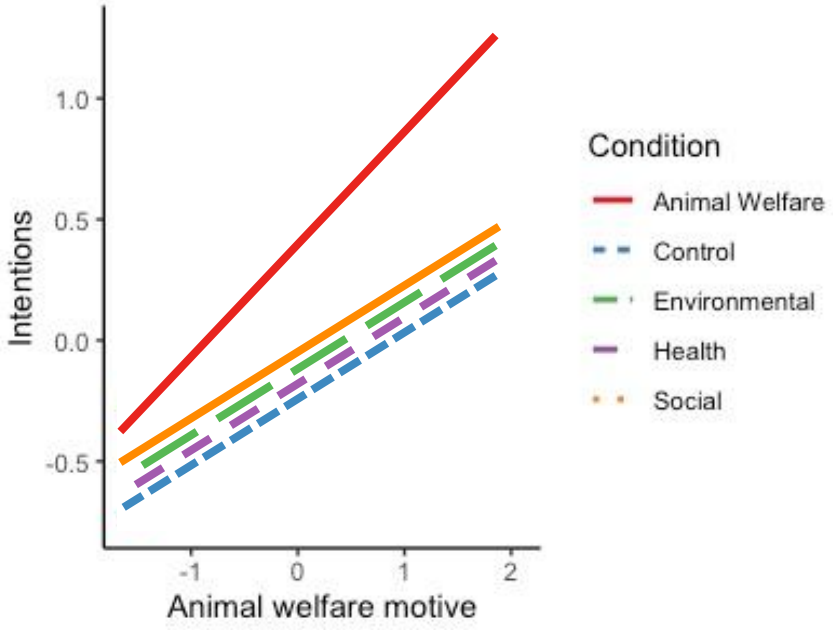
[5] Similarly, I used logistic regression to examine the effects related to whether or not the person selected a meal containing meat. The social motive ($\beta$ = -0.289, 95% CI [-0.591, 0.011], $p$ = 0.588) and health motive ($\beta$ = 0.303, 95% CI [-0.019, 0.638], $p$ = 0.070) were both marginally significant, although the health motive was in the unexpected direction; neither the environmental motive ($\beta$ = -0.048, 95% CI [-0.400, 0.302], $p$ = 0.787) nor the animal welfare motive ($\beta$ = -0.254, 95% CI [-0.584, 0.074], $p$ = 0.129) were significant.

variable. The ANOVA predicting intentions to reduce meat consumption from message condition was significant ($F(4,287) = 4.290$, $p = 0.002$); I ran a Tukey Honestly Significant Difference (HSD) *post hoc* test and, consistent with Hypothesis 2, that compared to participants in the control condition ($M = 2.611$, $SD = 0.998$), participants who read an environmental message reported significantly greater intentions to reduce their meat consumption ($M = 3.369$, $SD = 1.061$). No other between-group differences were statistically significant, which is inconsistent with Hypothesis 2; however, participants who read an animal welfare ($M = 3.000$, $SD = 1.114$), health ($M = 2.854$, $SD = 0.875$) or social ($M = 3.034$, $SD = 1.184$) message reported slightly (but non-significantly) greater intentions to reduce their meat consumption. Inconsistent with Hypothesis 2, there were no significant differences between conditions on attitudes towards meat ($F(4,286) = 0.624$, $p = 0.646$) or in selection of meals containing meat ($\chi^2(4)=5.109$, $p = 0.276$).

### *3.3.3. Hypothesis 3*

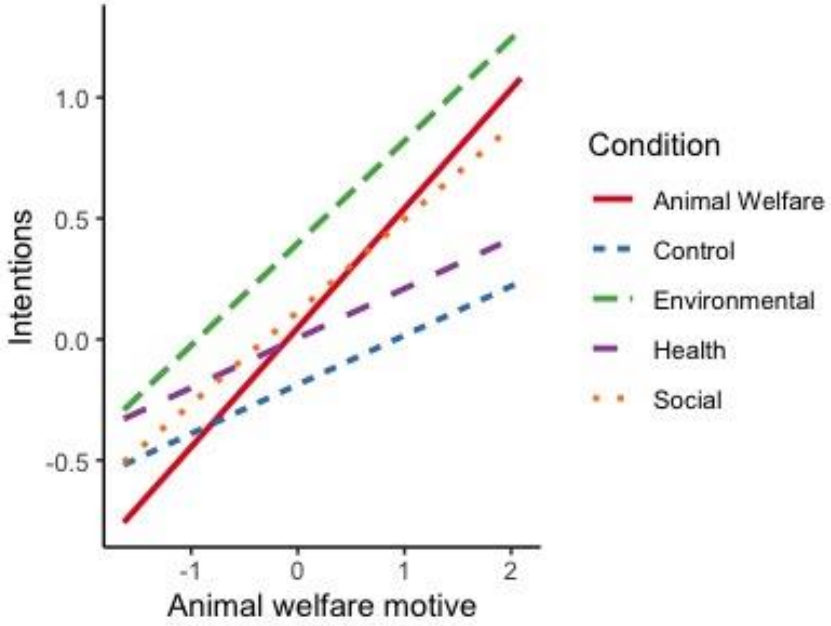
To test the matching effect (Hypothesis 3), I examined the interaction terms between each motive and the matched message. If there is a matching effect, the interaction (comparing the slope of the matched message to the slope of the no message control) should be significant such that people higher in a motive respond more positively to the corresponding message. Further, there should be no significant interaction with the other three messages (i.e., the slope of the mismatched message lines should not be different from the no message control). An example of this anticipated effect is depicted in Figure 2.

**Figure 2.** Example anticipated pattern of results for animal welfare matching.




***3.3.3.1. Intentions to reduce meat consumption.*** There was a marginally significant matching effect on intentions to reduce meat consumption for the animal welfare motive. That is, participants who scored higher on the animal welfare motivation and read a message related to animal welfare reported greater intentions to reduce their meat consumption compared to participants for whom the animal-welfare motive was less important (see Figure 3); there is a marginally significant interaction between the animal-welfare motive and the animal-welfare message, compared to the no-message control reference group (see Table 8). Moreover, none of the other interaction terms approach significance.

**Figure 3.** Matching effect for animal welfare motive on intentions to reduce meat consumption.




*Note:* The slope of the animal welfare condition line is marginally steeper than the control line, consistent with a matching effect. No other conditions are significantly different from the control line.

**Table 8.** Results of Intervention Study on intentions to reduce meat consumption

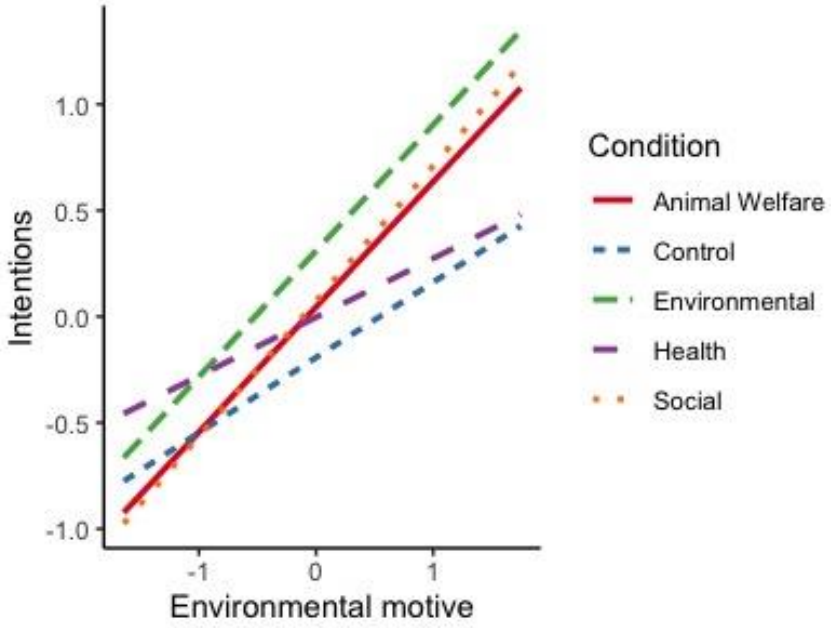
| **Parameter** | ***β* (95% CI)** | ***SE*** | ***p*** |
|---|---|---|---|
| *Animal Motive Match* | | | |
| Intercept | -0.330 (-0.575, -0.086) | 0.124 | 0.008 |
| Animal Motive | 0.214 (-0.018, 0.446) | 0.118 | 0.071 |
| Animal Message | 0.277 (-0.061, 0.614) | 0.171 | 0.108 |
| Env. Message | 0.645 (0.324, 0.966) | 0.163 | <0.001 |
| Health Message | 0.206 (-0.149, 0.56) | 0.180 | 0.255 |
| Social Message | 0.339 (0, 0.677) | 0.172 | 0.05 |
| **A. Motive x Animal Message** | **0.305 (-0.013, 0.623)** | **0.161** | **0.060** |
| A. Motive x Env. Message | 0.230 (-0.089, 0.550) | 0.163 | 0.157 |
| A. Motive x Health Message | 0.002 (-0.365, 0.368) | 0.186 | 0.993 |
| A. Motive x Social Message | 0.188 (-0.142, 0.518) | 0.168 | 0.264 |
| $F(10,282)=8.312$, $R^2=0.21$, $p<0.001$ | | | |

| **Parameter** | ***β* (95% CI)** | ***SE*** | ***p*** |
|---|---|---|---|
| *Environmental Motive Match* | | | |
| Intercept | -0.308 (-0.529, -0.087) | 0.112 | 0.007 |
| Env. Motive | 0.362 (0.149, 0.575) | 0.108 | 0.001 |
| Animal Message | 0.286 (-0.018, 0.591) | 0.155 | 0.065 |
| Env. Message | 0.570 (0.279, 0.862) | 0.148 | <0.001 |
| Health Message | 0.193 (-0.128, 0.515) | 0.163 | 0.237 |
| Social Message | 0.321 (0.016, 0.627) | 0.155 | 0.039 |
| E. Motive x Animal Message | 0.24 (-0.046, 0.527) | 0.146 | 0.100 |
| **E. Motive x Env. Message** | **0.244 (-0.044, 0.532)** | **0.146** | **0.096** |
| E. Motive x Health Message | -0.080 (-0.432, 0.273) | 0.179 | 0.657 |
| E. Motive x Social Message | 0.289 (-0.007, 0.586) | 0.151 | 0.056 |
| $F(10,282)=17.164$, $R^2=0.354$, $p<0.001$ | | | |
| *Health Motive Match* | | | |
| Intercept | -0.284 (-0.527, -0.041) | 0.123 | 0.022 |
| Health Motive | 0.378 (0.144, 0.611) | 0.119 | 0.002 |
| Animal Message | 0.171 (-0.166, 0.508) | 0.171 | 0.318 |
| Env. Message | 0.639 (0.321, 0.957) | 0.161 | <0.001 |
| Health Message | 0.143 (-0.208, 0.493) | 0.178 | 0.423 |
| Social Message | 0.289 (-0.045, 0.624) | 0.170 | 0.090 |
| H. Motive x Animal Message | 0.140 (-0.198, 0.479) | 0.172 | 0.415 |
| H. Motive x Env. Message | -0.003 (-0.317, 0.31) | 0.159 | 0.984 |
| **H. Motive x Health Message** | **-0.182 (-0.552, 0.189)** | **0.188** | **0.335** |
| H. Motive x Social Message | 0.141 (-0.172, 0.454) | 0.159 | 0.376 |
| $F(10,282)=9.621$, $R^2=0.235$, $p<0.001$ | | | |
| *Social Motive Match* | | | |
| Intercept | -0.353 (-0.602, -0.105) | 0.126 | 0.005 |
| Social Motive | 0.206 (-0.034, 0.446) | 0.122 | 0.092 |
| Animal Message | 0.351 (0.007, 0.695) | 0.175 | 0.045 |
| Env. Message | 0.696 (0.368, 1.023) | 0.166 | <0.001 |
| Health Message | 0.209 (-0.153, 0.572) | 0.184 | 0.257 |
| Social Message | 0.331 (-0.015, 0.678) | 0.176 | 0.061 |
| S. Motive x Animal Message | 0.213 (-0.124, 0.55) | 0.171 | 0.214 |
| S. Motive x Env. Message | 0.149 (-0.184, 0.482) | 0.169 | 0.379 |
| S. Motive x Health Message | -0.294 (-0.680, 0.092) | 0.196 | 0.135 |
| **S. Motive x Social Message** | **0.186 (-0.134, 0.506)** | **0.163** | **0.254** |
| $F(10,281)=1.056$, $R^2=0.033$, $p=0.396$ | | | |

*Note:* bolded rows are where I would expect to find significant effects if the matching hypothesis was supported

There is also a similar marginal matching effect for the environmental motive and the environmentally framed message (see Table 8). However, in this model there is also a marginally significant interaction between the environmental motive and the social message frame, which is not consistent with the hypothesis; that is, participants who scored higher on the environmental motive and read a social message expressed more intentions to reduce their meat consumption than individuals who scored lower in the environmental motive, as compared to the no message control reference group (see Figure 4). Contrary to hypotheses, the matching effects for health motives and social motives did not approach significance.

**Figure 4.** Matching effect for environmental motive on intentions to reduce meat consumption.




*Note:* The slope of the environmental condition line is marginally steeper than the control line, consistent with a matching effect. However, not in line with the predicted matching effect, the slope of the social line is also steeper than that of the control line.

***3.3.3.2. Attitudes towards meat.*** There were no significant matching effects for the measure of attitudes towards meat (see Table 9).

**Table 9.** Results of Intervention Study on attitudes towards meat

| **Parameter** | **$\beta$ (95% CI)** | ***SE*** | ***p*** |
|---|---|---|---|
| *Animal Motive Match* | | | |
| Intercept | -0.057 (-0.327, 0.214) | 0.137 | 0.681 |
| Animal Motive | -0.010 (-0.267, 0.246) | 0.130 | 0.936 |
| Animal Message | 0.041 (-0.332, 0.414) | 0.190 | 0.830 |
| Env. Message | 0.138 (-0.217, 0.493) | 0.180 | 0.445 |
| Health Message | 0.199 (-0.194, 0.591) | 0.199 | 0.320 |
| Social Message | -0.057 (-0.433, 0.319) | 0.191 | 0.767 |
| **A. Motive x Animal Message** | **-0.209 (-0.561, 0.143)** | **0.179** | **0.243** |
| A. Motive x Env. Message | -0.199 (-0.553, 0.155) | 0.180 | 0.269 |
| A. Motive x Health Message | -0.071 (-0.476, 0.335) | 0.206 | 0.732 |
| A. Motive x Social Message | -0.109 (-0.48, 0.262) | 0.188 | 0.564 |
| $F(10,281)=1.073$, $R^2=0.033$, p=0.383 | | | |
| *Environmental Motive Match* | | | |
| Intercept | -0.085 (-0.357, 0.187) | 0.138 | 0.540 |
| Env. Motive | -0.197 (-0.459, 0.065) | 0.133 | 0.140 |
| Animal Message | 0.049 (-0.326, 0.424) | 0.190 | 0.797 |
| Env. Message | 0.161 (-0.198, 0.519) | 0.182 | 0.379 |
| Health Message | 0.246 (-0.15, 0.641) | 0.201 | 0.222 |
| Social Message | -0.036 (-0.414, 0.342) | 0.192 | 0.851 |
| E. Motive x Animal Message | 0.147 (-0.206, 0.500) | 0.179 | 0.413 |
| **E. Motive x Env. Message** | **0.151 (-0.204, 0.506)** | **0.180** | **0.403** |
| E. Motive x Health Message | 0.364 (-0.069, 0.798) | 0.220 | 0.099 |
| E. Motive x Social Message | 0.158 (-0.213, 0.528) | 0.188 | 0.403 |
| $F(10,281)=0.664$, $R^2=0.021$, $p=0.741$ | | | |
| *Health Motive Match* | | | |
| Intercept | -0.045 (-0.319, 0.229) | 0.139 | 0.747 |
| Health Motive | 0.048 (-0.215, 0.312) | 0.134 | 0.718 |
| Animal Message | -0.013 (-0.394, 0.367) | 0.193 | 0.945 |
| Env. Message | 0.105 (-0.254, 0.463) | 0.182 | 0.566 |
| Health Message | 0.191 (-0.205, 0.586) | 0.201 | 0.343 |
| Social Message | -0.076 (-0.455, 0.303) | 0.192 | 0.692 |
| H. Motive x Animal Message | 0.052 (-0.330, 0.434) | 0.194 | 0.790 |
| H. Motive x Env. Message | -0.285 (-0.639, 0.069) | 0.180 | 0.114 |
| **H. Motive x Health Message** | **0.028 (-0.390, 0.447)** | **0.213** | **0.894** |
| H. Motive x Social Message | -0.097 (-0.450, 0.257) | 0.180 | 0.590 |
| $F(10,281)=0.824$, $R^2=0.026$, $p=0.594$ | | | |

| **Parameter** | **$\beta$ (95% CI)** | ***SE*** | ***p*** |
|---|---|---|---|
| *Social Motive Match* | | | |
| Intercept | -0.063 (-0.33, 0.205) | 0.136 | 0.646 |
| Social Motive | -0.169 (-0.427, 0.090) | 0.131 | 0.200 |
| Animal Message | 0.025 (-0.345, 0.396) | 0.188 | 0.893 |
| Env. Message | 0.131 (-0.222, 0.485) | 0.179 | 0.465 |
| Health Message | 0.196 (-0.195, 0.587) | 0.199 | 0.325 |
| Social Message | -0.031 (-0.407, 0.344) | 0.191 | 0.869 |
| S. Motive x Animal Message | 0.165 (-0.198, 0.528) | 0.184 | 0.372 |
| S. Motive x Env. Message | 0.046 (-0.312, 0.405) | 0.182 | 0.799 |
| S. Motive x Health Message | -0.038 (-0.454, 0.378) | 0.211 | 0.858 |
| **S. Motive x Social Message** | **-0.029 (-0.376, 0.317)** | **0.176** | **0.868** |
| $F(10,282)=6.309$, $R^2=0.168$, $p<0.001$ | | | |

*Note:* bolded rows are where I would expect to find significant effects if the matching hypothesis was supported.

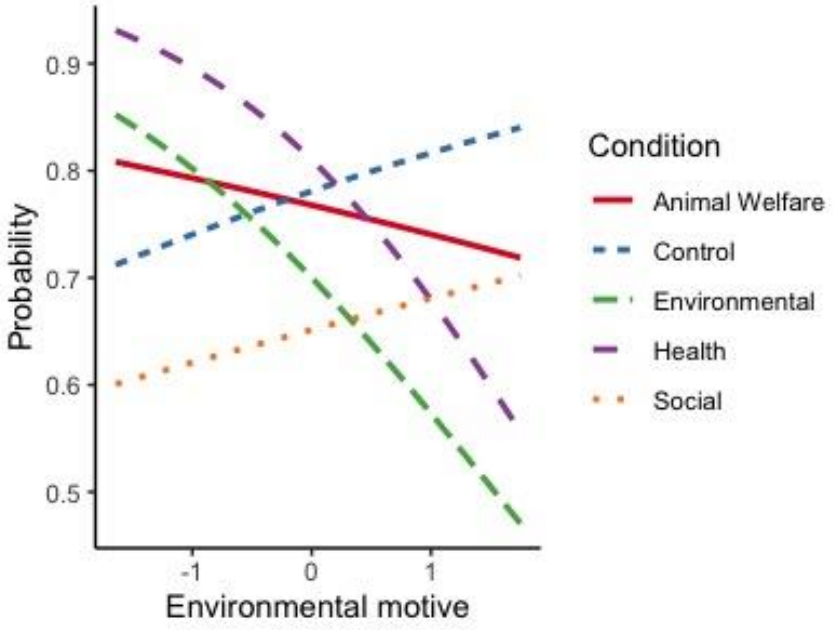
***3.3.3.3. Menu task.*** There was a marginal matching effect for the environmental motive. That is, participants who scored higher on the environmental motive and read an environmental message were less likely to select an item containing meat than participants who scored lower on the environmental motive (see Figure 5). Consistent with hypotheses, this effect was not found for any of the other messages (see Table 10). There were no significant matching effects for the animal welfare, health, or social motive.

**Table 10.** Results of Intervention Study on selecting a meal option containing meat

| **Parameter** | ***β* (95% CI)** | ***SE*** | ***OR* (95% CI)** | ***p*** |
|---|---|---|---|---|
| *Animal Motive Match* | | | | |
| Intercept | 1.266 (0.628, 1.997) | 0.345 | 3.545 (1.874, 7.369) | <0.001 |
| Animal Motive | -0.598 (-1.247, 0.007) | 0.314 | 0.55 (0.287, 1.007) | 0.057 |
| Animal Message | -0.098 (-1.024, 0.804) | 0.462 | 0.907 (0.359, 2.234) | 0.832 |
| Env. Message | -0.555 (-1.426, 0.266) | 0.428 | 0.574 (0.240, 1.305) | 0.195 |
| Health Message | 0.124 (-0.877, 1.153) | 0.511 | 1.132 (0.416, 3.168) | 0.808 |
| Social Message | -0.626 (-1.523, 0.224) | 0.442 | 0.535 (0.218, 1.251) | 0.156 |
| **A Motive x Animal Message** | **0.597 (-0.233, 1.451)** | **0.426** | **1.817 (0.792, 4.267)** | **0.161** |
| A Motive x Env. Message | 0.186 (-0.625, 1.009) | 0.413 | 1.205 (0.535, 2.743) | 0.652 |
| A Motive x Health Message | -0.043 (-1.100, 0.97) | 0.521 | 0.957 (0.333, 2.637) | 0.934 |
| A Motive x Social Message | 0.661 (-0.154, 1.505) | 0.420 | 1.937 (0.857, 4.504) | 0.115 |
| *Environmental Motive Match* | | | | |
| Intercept | 1.298 (0.670, 2.022) | 0.34 | 3.662 (1.955, 7.555) | <0.001 |
| Env. Motive | 0.212 (-0.416, 0.869) | 0.322 | 1.236 (0.66, 2.385) | 0.510 |
| Animal Message | -0.12 (-1.041, 0.778) | 0.459 | 0.887 (0.353, 2.177) | 0.794 |
| Env. Message | -0.518 (-1.393, 0.313) | 0.431 | 0.596 (0.248, 1.367) | 0.229 |
| Health Message | 0.067 (-0.924, 1.08) | 0.504 | 1.07 (0.397, 2.944) | 0.894 |
| Social Message | -0.656 (-1.547, 0.188) | 0.439 | 0.519 (0.213, 1.206) | 0.135 |
| E Motive x Animal Message | -0.353 (-1.216, 0.482) | 0.430 | 0.703 (0.296, 1.62) | 0.411 |
| **E Motive x Env. Message** | **-0.738 (-1.597, 0.082)** | **0.425** | **0.478 (0.202, 1.086)** | **0.083** |
| E Motive x Health Message | -0.88 (-2.026, 0.188) | 0.559 | 0.415 (0.132, 1.207) | 0.115 |
| E Motive x Social Message | -0.086 (-0.924, 0.741) | 0.421 | 0.917 (0.397, 2.097) | 0.838 |
| *Health Motive Match* | | | | |
| Intercept | 1.246 (0.627, 1.947) | 0.333 | 3.477 (1.873, 7.006) | <0.001 |
| Health Motive | -0.033 (-0.666, 0.613) | 0.321 | 0.968 (0.514, 1.847) | 0.918 |
| Animal Message | -0.126 (-1.033, 0.764) | 0.455 | 0.881 (0.356, 2.147) | 0.781 |
| Env. Message | -0.57 (-1.410, 0.226) | 0.414 | 0.566 (0.244, 1.253) | 0.169 |
| Health Message | 0.095 (-0.864, 1.070) | 0.488 | 1.1 (0.421, 2.915) | 0.845 |
| Social Message | -0.602 (-1.474, 0.235) | 0.433 | 0.548 (0.229, 1.264) | 0.164 |
| H Motive x Animal Message | 0.407 (-0.509, 1.344) | 0.468 | 1.502 (0.601, 3.833) | 0.385 |
| H Motive x Env. Message | 0.079 (-0.727, 0.878) | 0.406 | 1.083 (0.483, 2.407) | 0.845 |
| **H Motive x Health Message** | **-0.106 (-1.148, 0.909)** | **0.519** | **0.899 (0.317, 2.481)** | **0.838** |
| H Motive x Social Message | -0.011 (-0.820, 0.789) | 0.407 | 0.989 (0.440, 2.202) | 0.979 |
| *Social Motive Match* | | | | |
| Intercept | 1.253 (0.643, 1.940) | 0.328 | 3.501 (1.903, 6.962) | <0.001 |
| Social Motive | 0.009 (-0.58, 0.715) | 0.317 | 1.009 (0.56, 2.044) | 0.978 |
| Animal Message | -0.072 (-0.967, 0.814) | 0.451 | 0.93 (0.38, 2.257) | 0.873 |
| Env. Message | -0.565 (-1.401, 0.232) | 0.414 | 0.568 (0.246, 1.262) | 0.172 |
| Health Message | 0.077 (-0.872, 1.042) | 0.484 | 1.08 (0.418, 2.835) | 0.874 |
| Social Message | -0.563 (-1.432, 0.28) | 0.434 | 0.57 (0.239, 1.322) | 0.195 |
| S Motive x Animal Message | -0.242 (-1.13, 0.589) | 0.429 | 0.785 (0.323, 1.802) | 0.572 |
| S Motive x Env. Message | -0.506 (-1.383, 0.282) | 0.417 | 0.603 (0.251, 1.326) | 0.225 |
| S Motive x Health Message | -0.151 (-1.166, 0.864) | 0.506 | 0.86 (0.311, 2.373) | 0.765 |
| **S Motive x Social Message** | **-0.287 (-1.129, 0.47)** | **0.399** | **0.75 (0.323, 1.599)** | **0.472** |

*Note:* bolded rows are where I would expect to find significant effects if the matching hypothesis was supported

**Figure 5.** Matching effect for environmental motive on the menu selection task.




*Note*: The y-axis is the probability of selecting an item containing meat. The slope of the environmental condition line is marginally steeper than the control line, consistent with a matching effect. No other conditions are significantly different from the control line.

### *3.3.4. Secondary Hypotheses*

For these analyses, I also included a portion of the sample that was filtered out when evaluating the intervention to avoid floor effects: individuals who said they were "not at all willing" to reduce their current meat consumption, resulting in a sample of 346 participants.

#### *3.3.4.1. Relation between new (continuous) measure of motives and categorical motives.*

I computed the point-biserial correlations between individuals' continuous animal-welfare, environmental, and health motive scores and their endorsement (yes/no) of categorical motives (see Appendix F for exact wording; see Table 11 for correlations). I would expect the continuous animal-welfare motive scores to be highly correlated with the categorical animal-welfare motive, the continuous environmental motive scores to be

highly correlated with the categorical environmental motive scores, and the continuous health motive scores to be highly correlated with the categorical health and weight loss motive scores.

In line with this prediction, the continuous animal-welfare motive score is correlated with the categorical animal-welfare score ($r = 0.59$, $p < 0.001$), and the magnitude of this correlation is stronger than the correlation between the categorical animal-welfare motive and the environmental motive ($r = 0.35$), the health motive ($r = 0.18$), and the social motive ($r = 0.17$). Similarly, continuous environmental motive scores are correlated with categorical environmental motive scores ($r = 0.64$, $p < 0.001$), and the magnitude of this correlation is stronger than the correlation between the categorical environmental motive and the continuous animal-welfare motive scores ($r = 0.30$), the continuous health motive scores ($r = 0.26$), or the continuous social motive scores ($r = 0.22$). The same pattern of results is present for the correlation between the continuous health motive and the categorical health motive scores ($r=0.48$, $p<0.001$) and the categorical weight loss motive ($r=0.31$, $p<0.001$); they are stronger than the correlations between the categorical health and weight loss motives with the continuous animal welfare motive ($r=0.04$ and r=-0.01), the continuous environmental motive ($r=0.17$ and r=0.06), and the continuous social motive ($r=0.16$ and r=0.14).

**Table 11.** Correlation table for motivation measures and willingness to reduce meat consumption.

| Variable | Mean | SD | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Animal mot. | 13.65 | 5.35 | | | | | | | | | | | | | | |
| 2. Env. motive | 14.56 | 5.89 | 0.64*** | | | | | | | | | | | | | |
| 3. Health motive | 14.58 | 5.12 | 0.45*** | 0.55*** | | | | | | | | | | | | |
| 4. Social motive | 8.37 | 3.86 | 0.44*** | 0.49*** | 0.50*** | | | | | | | | | | | |
| 5. R&B prosoc. | 16.15 | 8.79 | 0.34*** | 0.40*** | 0.36*** | 0.45*** | | | | | | | | | | |
| 6. R&B personal | 12.16 | 4.82 | 0.03 | 0.06 | 0.28*** | 0.13* | 0.55*** | | | | | | | | | |
| 7. R&B moral | 7.24 | 4.39 | 0.27*** | 0.26*** | 0.26*** | 0.39*** | 0.87*** | 0.45*** | | | | | | | | |
| 8. Cat. health | 0.76 | 0.43 | 0.04 | 0.17** | **0.48*** ** | 0.16** | 0.13* | 0.17** | 0.07 | | | | | | | |
| 9. Cat. weight | 0.44 | 0.5 | -0.01 | 0.06 | **0.31*** ** | 0.14* | 0.05 | 0.09 | 0.04 | 0.27*** | | | | | | |
| 10. Cat. animal | 0.64 | 0.48 | **0.59*** ** | 0.35*** | 0.18*** | 0.17** | 0.16** | 0 | 0.11* | 0.04 | -0.02 | | | | | |
| 11. Cat. religion | 0.04 | 0.2 | 0.16** | 0.08 | 0.05 | 0.08 | 0.19*** | 0.11 | 0.19*** | -0.01 | 0.01 | 0.13* | | | | |
| 12. Cat. env. | 0.72 | 0.45 | 0.30*** | **0.64*** ** | 0.26*** | 0.22*** | 0.22*** | 0.02 | 0.13* | 0.09 | 0.02 | 0.30*** | 0.1 | | | |
| 13. Cat. taste | 0.12 | 0.33 | 0.04 | 0.01 | 0.04 | 0.1 | -0.03 | 0.07 | -0.04 | -0.09 | 0.02 | -0.04 | 0.09 | -0.07 | | |
| 14. Cat. access | 0.07 | 0.25 | -0.07 | -0.16** | -0.17** | -0.05 | 0 | -0.01 | 0 | -0.23*** | -0.09 | -0.06 | 0 | -0.17** | 0 | |
| 15. Willingness | 2.36 | 0.91 | **0.37*** ** | **0.54*** ** | **0.38*** ** | **0.25*** ** | **0.24*** ** | **0.11** | **0.17** ** | **0.19*** ** | **0.1** | **0.25*** ** | **0.04** | **0.30*** ** | **0.06** | **-0.16** ** |

Note: * $p < .05$, ** $p < .01$, *** $p < .001$

Motives 1-4 are from the scale developed in this project; motives 5-7 are from the scale developed by Rosenfeld & Burrow (2018); motives 8-14 are yes/no endorsements of single items about health, weight loss, animal welfare, religious, environmental, taste/preference/aversion, and access motives; willingness is the screener item "How willing are you to consider reducing your current meat consumption?" administered before the intervention

Correlations discussed in the text are bolded.

***3.3.4.2. Comparing new motives measure to existing measures.*** I also examined the relation between measures of motivations (my new measure, Rosenfeld and Burrow's (2018) measure, categorical measures) and willingness to reduce meat consumption. This was one of the screening criteria and was administered before any of the other study materials. The four subscales of my new measure correlate significantly with willingness to reduce meat consumption (*r*'s between 0.25 and 0.54; see Table 11). Moreover, the magnitude of these correlations is higher than any of the correlations with Rosenfeld and Burrow's scale or any of the categorical motives, except the categorical environmental motive. And the environmental motive on my scale is more highly correlated with willingness to reduce meat consumption than the categorical motive ($r = 0.54$, 95% CI [0.462, 0.612] vs. $r = 0.30$, 95% CI [0.197, 0.390]; confidence intervals to do not overlap).

## 3.4. Discussion

In this intervention study, I assessed three primary hypotheses and compared the utility of my novel measure to existing methods of assessing motivations for following a plant-based diet. In support of Hypothesis 1, I found that each of the motives was significantly related to intentions to reduce meat consumption. The animal-welfare and social motives were also both significantly related to attitudes towards meat and selecting meat from a menu in the expected direction; the environmental and social motives were not significantly related to these two outcomes. Thus, each of the motives is important in predicting intentions to reduce meat consumption, but animal welfare and health motives have more predictive utility in attitudinal and behavioral domains.

In partial support of Hypothesis 2, I found that the environmental message was more effective in eliciting intentions to reduce meat consumption, compared to no message at all. Although the animal-welfare, health, and social messages also yielded greater intentions to reduce meat consumption compared to no message at all, these differences did not reach the level of statistical significance. Message frames also did not influence participants' attitudes toward meat nor their choices when they selected from an array of dishes on menus containing meat and vegetarian options. Thus, there is some evidence that the environmental message is the most effective in eliciting favorable outcomes. However, the lack of difference between the four experimental manipulations and the no message control condition might also be indicative of the fact that the manipulations were too weak to elicit an effect.

There were no significant effects of message frames that would have supported Hypothesis 3, the matching hypothesis. However, there were marginal effects suggesting that individuals for whom animal-welfare motives predominated (compared to individuals for whom such motives were less important) reported stronger intentions to reduce their meat consumption after reading the animal-welfare message. The same effect held for the environmental motive and intentions to reduce meat consumption, with the caveat that the social message also had a slope significantly different from the no message control. There was a similar pattern of results for matching to the environmental motive on the menu task, such that individuals for whom environmental motives were relatively stronger (compared to individuals for whom the motive was less important) were marginally less likely to select a dish containing meat. Thus, the environmental motive has the most evidence for a somewhat effective matching effect.

Last, there is some evidence that this new measure has more predictive utility than both Rosenfeld and Burrow's (2018) measure of dietary identity and single-item categorical measures of motivation to decrease meat consumption. Also, individuals' environmental motive was the more strongly correlated motive with willingness to reduce meat consumption.

Given the marginal utility of matching persuasive messages to environmental motives, in combination with the fact that individuals who read the environmental message were the only group who expressed significantly greater intentions to reduce their meat consumption than individuals who read no message, this is the motive that has the potential to be most useful in future similar interventions.

## 4. General Discussion

The goals of this line of research were to (1) develop a theoretically grounded conceptualization of motives to follow a plant-based diet, (2) create a psychometrically validated instrument with which to measure these motives, (3) expand these constructs to encapsulate omnivores' motives for reducing their meat consumption, and (4) design a psychological intervention aimed at decreasing omnivores' meat consumption through functional message matching. The measure development portion of this project addressed the first three goals; I created a novel motives measure with a four-factor structure (animal welfare, environmental, health, and social) that can be modified for use in both vegetarian/vegan and omnivore samples. The intervention portion addressed the fourth; I ran an intervention in which participants read persuasive messages relating to one of the four motives. I found no matching effects but did find some evidence that environmental messages are the most persuasive.

### 4.1. Implications

The measure I developed builds upon our existing understanding of vegetarian motives by incorporating both motives that have been identified for decades in the qualitative literature (Jabs et al., 1998; Ruby, 2012) and functionalist theory, a classic theory in personality and social psychology (Carpenter et al., 2013; Herek, 1987; Snyder & DeBono, 1985). Additionally, this novel measure better predicts omnivores' willingness to reduce their meat consumption than similar single-item measures and other conceptualizations of dietary motives (Rosenfeld & Burrow, 2018). This measure can be used in future studies of both vegetarians/vegans and omnivores who are considering dietary changes in meat consumption.

Moreover, although the intervention study did not yield significant matching effects, there were a few useful findings. The persuasive appeal that described the environmental benefits of reducing meat consumption was the most effective influence on participants' self-reported intentions to reduce meat consumption and elicited the most consistent marginal matching effects. As a result, environmental appeals (as opposed to health, social, or animal welfare) may be the most useful persuasive method in future studies.

However, this contradicts previous findings that health and environmental messages are equally effective (Carfora et al., 2019) or that animal welfare messages outperform environmental messages (Scrimgeour, 2012). Given the increasingly dire state of climate change, is possible that environmental motives have become more salient for individuals in the past decade, which makes these types of appeals more effective (compared to other types of appeals) than they were in the past. This would be consistent

with the fact that American adults are increasingly more concerned about global warming (Saad & Jones, 2016).

Alternatively, the environmental appeals might have communicated more new information to participants about the implications of meat consumption than the health, animal welfare, or social messages. The health and animal welfare benefits of plant-based diets are well-documented and have been relatively consistently discussed over the past few decades, which is consistent with the fact that they regularly are espoused by vegetarians and vegans as motivations to follow their diet in the qualitative literature (Hopwood et al., 2020). Conversely, the environmental impacts of plant-based diets are communicated much less frequently; Wynes and Nicholas (2017) found that no high school science textbooks mentioned plant-based diets as an effective way to mitigate climate change and that Australia, the United States, Canada, and the European Union all failed to include plant-based diets or reducing meat consumption in their official recommendations to reduce individual greenhouse gas emissions. Simply informing people that plant-based diets are an important action could have driven the effect in this study and could continue to be an important type of intervention moving forward.

### 4.2. Limitations

In the measure development portion of this project, the biggest limitations are likely related to the samples. In order to recruit vegetarians and vegans for Sample 1, I posted on Facebook groups, which means that I necessarily recruited vegetarians/vegans whose diet-related identities are central enough to lead them to participate regularly in Facebook groups. It is possible that a sample of vegetarians/vegans not on these groups might have responded to the motive items differently; the stem of the questions was

slightly different ("I eat a plant-based diet because…" vs. "I might consider reducing my meat consumption because…") and vegetarians/vegans were reflecting on their current motives whereas omnivores were speculating about future motives. I recruited Samples 2 and 3 from Prolific, which has some measures of quality control, but certainly is not a representative sample of either the United States (Sample 2) or the broader international community (Sample 3). Additionally, Samples 2 and 3 were collected while COVID-19 restrictions were still in place in many locations, so it is possible that participants had different attitudes towards food than they might have under more normal circumstances (e.g., preparing more of their own food as opposed to eating out).

The intervention portion of this project had a few notable weaknesses. First, because of budget constraints and COVID-19 logistical factors, this study could not involve any measure of actual eating behaviors. Instead, I measured behaviors by having individuals select a hypothetical meal from a menu. This study might also have been underpowered to detect the small effects that could be expected from this type of intervention.

Additionally, the combination of (1) the lack of significant differences related to hypothesis 2, that reading any of the persuasive messages should elicit greater intentions to reduce one's meat consumption, more negative attitudes towards meat, and a lower likelihood of selecting a menu item containing meat, and (2) the lack of matching effect might also be due to the fact that the manipulations were too weak to elicit an effect. Last, it is possible that individuals who were not already highly motivated to change their diet would not be persuaded by these interventions; dietary behaviors are particularly difficult to change (Standen et al., 2018), thus or exclusion criteria of only filtering out

individuals who were “not at all willing” to reduce their meat consumption might have been insufficient to only include participants who might actually be convinced to alter their dietary behaviors in an intervention such as this.

### 4.3. Future Directions

Future research could address these all but unavoidable shortcomings. Validating the measure on another sample of vegetarians/vegans not recruited through Facebook groups and running an additional study on the predictive validity and reliability of the measure would easily address some of the measurement limitations. Additionally, collecting data from a more representative omnivore sample is another straightforward step towards strongly validating the psychometric properties of this scale.

I believe that future interventions could capitalize on these motives in a more ecologically valid way that might better allow for matching effects to arise. For example, two important message-related characteristics should be altered in future interventions. First, participants should encounter the same or similar messages repeatedly. In practice, this can be achieved by creating analogs of a television advertisement, web advertisement, or even text message alert (Carfora et al., 2019). People receive so much information daily, that if an intervention has any chance of making a lasting impact, it likely needs to be delivered repeatedly.

Second, interventions should incorporate objective measures of eating behavior. Two promising ways to do this are by (1) having participants keep detailed food diaries about their meat consumption (Lacroix & Gifford, 2020) or (2) covertly measuring participants’ actual meat consumption in a paradigm in a laboratory (Wagner et al., 2014), or even in a setting outside of the laboratory (Christie & Chen, 2018; Reinders et

al., 2020). These improvements to the study design may make matching effects more apparent.

Third, the intervention materials should be strengthened in an attempt to elicit dietary changes. This could involve using stronger language but could also involve incorporating images into the manipulations, which might better capture the participants' attention and communicate the importance of the message. Meta-analytic work shows that message length is not a significant determinant of efficacy, but there is some (albeit inconsistent) evidence that adding images to messages results in more persuasion (Joyal-Desmarais, 2020). At the very least, images do not decrease the efficacy of messages, thus adding images to the relatively short text-based messages could be a useful avenue moving forward. This kind of multi-modal persuasive techniques have also been successfully scaled into large-scale interventions (Matz et al., 2017).

### 4.4. Conclusions

In this line of research, I present a psychometrically validated measure of vegetarian/vegan motives that can be adapted to measure omnivore's motives for reducing their current meat consumption. I also designed a message-matching intervention in which persuasive messages were matched to individual's motives. Although the matched messages were not more effective in individuals highly motivated in a specific domain (e.g., environment, health), there was evidence that environmentally framed messages may be the most useful avenue moving forward.

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# 6. Appendices

## Appendix A. List of Facebook groups used for recruiting

Canadian Vegetarians and Vegans
Capital Region Vegan Network
Chicago area Vegetarian, Vegan & Raw Foodist community
Friendly and pragmatic vegans and vegetarians
Friendly Vegans
Happy Vegans
Iowa Vegetarian
Learning Vegans
ONE BILLION VEGANS
Pescatarian/Vegetarian Lifestyle
Plant-based endurance athletes
Plant-Based, Vegan, and Vegetarian Community of New York
The Happy Vegetarian
Vegan Iowa
Vegan Is Peace
Vegan Living
Vegan Minnesota
Vegan Researchers & Enthusiasts
Vegan Vegetarian Support Group
Vegan, Vegetarian & Plant-Based
Vegans of Minnesota
Vegetarian & Vegan Questions and Answers Support Group
Vegetarians
Vegetarians and Vegans
Vermont Vegans

**Appendix B. Sample 1 materials**

Please select the following items that you DO consider to be a regular and acceptable part of your vegetarian/vegan diet.

- Milk/dairy products
- Eggs
- Honey
- Gelatin
- Fish
- Chicken
- Beef
- Pork
- Other meat products (e.g., lamb, duck, etc.)
- None of the above

Please answer the following questions about your motivations for following a plant-based diet. Note: The term "plant-based diet" is meant to encompass both vegetarianism and veganism in this context. (Five-point Likert scale: 1= not at all true, 2=slightly true, 3=moderately true, 4=very true, 5=extremely true)

I eat a plant-based diet because it...

1. Helps me feel less guilty about the cruel treatment of animals (protective/animal)
2. Helps me avoid becoming sick (protective/health)
3. Makes me feel less guilty about the negative impact my actions have on the environment (protective/environment)
4. Allows me to do my part to prevent animals from suffering (protective/animal)
5. Is one thing I can do to prevent climate change (protective/environment)
6. Helps to lower my risk of contracting a serious disease (protective/health)
7. Allows me to express my values about my health (values/health)
8. Is consistent with my opinions about animal welfare (values/animal)
9. Is consistent with my other opinions about environmentalism (values/environment)
10. Allows me to connect with other people (social)
11. Makes me feel like I’m part of a larger community (social)
12. Allows me to spend more time with people who are important to me (social)
13. Helps me learn more about the environmental impact of eating animal products (understanding/environment)
14. Helps me understand the way food is connected to environmental problems (understanding/environment)
15. Allows me to understand the connection between what I eat and how I feel (understanding/health)
16. Allows me to learn how to eat in a way that is sustainable for the Earth (understanding/environment)
17. Helps me understand the way animals are involved in our food system (understanding/animal)

18. Makes me feel strong (esteem)
19. Helps me feel like I am advancing animal welfare (esteem/animal)
20. Helps me feel like I'm doing something important (esteem)
21. Makes me feel like I am doing enough to address animal cruelty (esteem/animal)
22. Makes me feel like I am doing enough to address environmental problems (esteem/environmental)
23. Makes me feel like my body is working as it should (instrumental/health)
24. Will help me to live longer (instrumental/health)
25. Prevents animal suffering (instrumental/animal)

I eat a plant-based diet because...

1. I can avoid developing severe diseases as I age (protective/health)
2. It prevents me from gaining weight (protective/health)
3. It helps me avoid feeling guilty after I eat meat (protective)
4. I want to live a healthy lifestyle and spend time with people who are important to me (values/health)
5. I feel compassion towards animals used in food production (values/animal)
6. It is important to have a healthy diet (values/health)
7. It allows me to express values that are important to me (values)
8. I want to express my values about animal welfare (values/animal)
9. It is consistent with other health behaviors that are important to me (values/health)
10. I believe it is wrong to kill another living being when I have other options for food (values/animal)
11. My friends eat a plant-based diet (social)
12. People in my community value eating a plant-based diet (social)
13. I'm a part of groups that value eating a plant-based diet (social)
14. The people I most often eat meals with follow a plant-based diet (social)
15. Important people in my life think eating a plant-based diet is important (social)
16. It allows me to learn more about animal welfare (understanding/animal)
17. It helps me to learn about my own health (understanding/health)
18. It makes me feel more connected to my food (understanding)
19. I want to gain a better understanding of where my food comes from (understanding)
20. It makes me feel good about myself (esteem)
21. It makes me feel good about my relationship with food (esteem)
22. It makes me feel better about my health (esteem/health)
23. It makes me happy (esteem)
24. Following this diet will help me lose weight (instrumental/health)
25. I want to save money on food (instrumental)
26. I want to save money on healthcare (instrumental/health)
27. I want to lessen my environmental impact (instrumental/environment)
28. It is a way of accomplishing one of my goals (instrumental)
29. It is easier for me to eat a plant-based diet than to eat animal products (instrumental)
30. My family members have experienced poor health because of their consumption of animal products (personal experience/health)

31. I've seen the ways that plant-based diet has benefited people that I know (personal experience)
32. I have seen animals suffering in order to produce food (personal experience/animal)
33. I have seen the negative effects of factory farming (personal experience)
34. Animal products have negatively impacted my health (personal experience/health)
35. I have seen the negative environmental consequences related to animal products (personal experience/environment)
36. I expect that I will be negatively impacted by climate change if we do nothing (personal experience/environment)
37. I have seen the poor conditions of factory farms (personal experience/animal)

Questions about diet:

1. Please indicate, to the closest month, how long you have followed a plant-based diet.
2. In your own words, please describe why you choose to follow a plant-based diet.
3. Please select which of the following reasons for following a plant-based diet best describes your **current primary motivation**.
    a. Improved health
    b. Weight-loss
    c. Animal welfare
    d. Religious and spiritual beliefs
    e. Environmental reasons
    f. Taste preference (aversion)
    g. Lack of access to meat and/or animal products (constraints)
4. Please select which of the following reasons for following a plant-based diet best describes your **other current** motivations. (Select all that apply)
    a. Improved health
    b. Weight-loss
    c. Animal welfare
    d. Religious and spiritual beliefs
    e. Environmental reasons
    f. Taste preference (aversion)
    g. Lack of access to meat and/or animal products (constraints)
5. Please select which of the following reasons for following a plant-based diet best describes your **initial primary motivation.**
    a. Improved health
    b. Weight-loss
    c. Animal welfare
    d. Religious and spiritual beliefs
    e. Environmental reasons
    f. Taste preference (aversion)
    g. Lack of access to meat and/or animal products (constraints)
6. Please select which of the following reasons for following a plant-based diet best describes your **other initial** motivations. (Select all that apply)

a. Improved health
b. Weight-loss
c. Animal welfare
d. Religious and spiritual beliefs
e. Environmental reasons
f. Taste preference (aversion)
g. Lack of access to meat and/or animal products (constraints)

## Appendix C. Samples 2 and 3 materials

Screening Criteria
Are not currently/have not recently limited meat consumption with a structured diet. If participants answer yes to either question they will not be allowed to participate in the study.

1. Are you currently following a pescatarian, vegetarian, or vegan diet?
    a. Yes
    b. No
2. Have you followed a pescatarian, vegetarian, or vegan diet in the past two years?
    a. Yes
    b. No

Same measure of vegetarian motives as studies 1 and 2, but question stems are replaced with

- "I might consider reducing my meat consumption because…"
- "I might consider reducing my meat consumption because this reduction would…"

Assessment of categorical motives

1. Please select **all** of the reasons for reducing meat consumption that are compelling to you.
    a. Improved health
    b. Weight-loss
    c. Animal welfare
    d. Religious and spiritual beliefs
    e. Environmental reasons
    f. Taste preference (aversion)
    g. Lack of access to meat and/or animal products (constraints)
2. Please rank the following reasons for reducing meat consumption from most-compelling to least-compelling.
    a. Improved health
    b. Weight-loss
    c. Animal welfare
    d. Religious and spiritual beliefs
    e. Environmental reasons
    f. Taste preference (aversion)
    g. Lack of access to meat and/or animal products (constraints)

Interest in reducing meat consumption
How likely are you to transition to a diet with less meat in it?

Diet Specification
Assess which animal products participants currently include in their diet.

1. Please select the following items that you DO consider to be a regular and acceptable part of your vegetarian/vegan diet.
    a. Pork
    b. Beef
    c. Chicken
    d. Fish
    e. Other meat products (e.g., lamb, duck, etc.)
    f. Milk/dairy products
    g. Eggs
    h. Honey
    i. Gelatin
    j. None of the above
2. On average, how many of your meals per week contain meat? [sliding scale from 0-21]

## Appendix D. Intervention Study Persuasive Appeals

Inspired by messages used by Lacroix and Gifford (2020), Carfora, Catellani, Caso, & Conner (2019), and Sparkman & Walton (2017)

### Environmental

There are a number of positive environmental impacts that are related to eating fewer meat and animal products. In fact, studies have found that eating less meat is one of the most effective and feasible ways to address a number of environmental issues. Diets with fewer animal products are associated with lower levels of:

- Greenhouse gas emissions
- Water usage and water pollution
- Biodiversity loss
- Desertification and deforestation
- Air pollution

One way to lessen the environmental impact of your diet is to adopt a "reducetarian" approach — this is done by simply eating less meat and more plants. This means choosing leaner meats and plant-based proteins, and eating red (beef, pork, lamb, goat) and processed meats only on occasion.

### Animal Welfare

There are a number of positive outcomes for animals that are related to eating fewer meat and animal products. In fact, studies have found that eating less meat is one of the most effective and feasible ways to address a number of animal welfare issues. Diets with fewer animal products are beneficial to animals based on a few types of moral reasoning:

- Animals experience pain and shouldn't be viewed as food resources for humans when we have other feasible options
- Using animals in food production results in greater total amounts of suffering than plant-based alternatives
- Livestock animals like pigs and cows are just as intelligent as household pets like dogs and cats, so we should treat them with the same respect

One way to lessen the impact of your diet on animal welfare is to adopt a "reducetarian" approach — this is done by simply eating less meat and more plants. This means choosing leaner meats and plant-based proteins, and eating red (beef, pork, lamb, goat) and processed meats only on occasion.

### Health

There are a number of positive health outcomes that are related to eating fewer meat and animal products. In fact, studies have found that eating less meat is one of the most

effective and feasible ways to address a number of health issues. Diets with fewer animal products are associated with lower levels of:

- Cancer
- Obesity
- Heart disease
- Diabetes
- Joint problems

One way to lessen the health impacts of your diet is to adopt a "reducetarian" approach — this is done by simply eating less meat and more plants. This means choosing leaner meats and plant-based proteins, and eating red (beef, pork, lamb, goat) and processed meats only on occasion.

**Social**

There are a number of positive social outcomes that are related to eating fewer meat and animal products. In fact, recent research has shown that, in the last 5 years, 30% of Americans have now started to make an effort to limit their meat consumption. That means that 3 in 10 people have changed their behavior to eat less meat than they otherwise would. Diets with fewer animal products are beneficial because this type of diet will:

- Help you to continue to fit in with your peers
- Allow you to foster a sense of shared identity with others
- Enable you to share meals with friends and family making similar dietary changes

One way to keep your diet on pace with that of other Americans is to adopt a "reducetarian" approach — this is done by simply eating less meat and more plants. This means choosing leaner meats and plant-based proteins, and eating red (beef, pork, lamb, goat) and processed meats only on occasion.

**No Message Control**

**Appendix E. 20-item measure of motives**

Omnivore stems (vegetarian stems; note: some verbiage needs to be altered)

(E=environmental, A=animal welfare, H=health, S=social)
Items should be presented in a random order and be on a five-point Likert scale with anchors 1=not at all true, 2=slightly true, 3=moderately true, 4=very true, 5=extremely true.

I would consider reducing my meat consumption because (I eat a plant-based diet because)

1. I want to lessen my environmental impact (E)
2. I expect that I will be negatively impacted by climate change if we do nothing (E)
3. It is consistent with my other opinions about environmentalism (E)
4. I feel compassion towards animals used in food production (A)
5. I want to express my values about animal welfare (A)
6. I believe it is wrong to kill another living being (A)
7. I have seen animals suffering in order to produce food (A)
8. It is important to have a healthy diet (H)
9. My friends eat a plant-based diet (S)
10. People in my community value eating a plant-based diet (S)
11. Important people in my life that that eating a plant-based diet is important (S)

I would consider reducing my meat consumption because this reduction would (I eat a plant-based diet because it)

1. Help me understand the way food is connected to environmental problems (E)
2. Allow me to learn how to eat in a way that is sustainable for the Earth (E)
3. Prevent animal suffering (A)
4. Help lower m risk of contracting a serious disease (H)
5. Allow me to understand the connection between what I eat and how I feel (H)
6. Make me feel like my body is working as it should (H)
7. Help me live longer (H)
8. Allow me to connect with other people (S)
9. Make me feel like I’m part of a larger community (S)

## Appendix F. Intervention Study Dependent Measures and Additional Moderators

### Intentions to reduce meat consumption

How likely are you to transition to a diet with less meat in it?

a. Not at all likely
b. Slightly likely
c. Moderately likely
d. Very likely
e. Extremely likely

### Attitudes towards meat

The following section of the questionnaire aims at finding out about your ideas and impressions about meat. In answering the questions, we would like to ask you to rate these concepts on a number of scales. These all have pairs of opposites at each end, and between these there are 5 bubbles. Select one of the five bubbles, indicating how you feel about the particular concept in view of the two poles.

1. Bad – good
2. Unpleasant – pleasant
3. Against – for
4. Unfavorable – favorable
5. Negative – positive

### Menu task

This is a binary outcome: if the participant selects a product containing meat or not. "Imagine that you are at this restaurant and are ordering your next meal (lunch/dinner). You can select as little or as much food as you want, but please order foods that you would actually like to have right now. To choose an item, click on its description. When selected, the item should be highlighted in color."

# Menu

## SOUPS

**Macaroni & Cheese | 880 cal**
small shells in a creamy cheese sauce with cheddar and parmesan cheeses

**12 Veggie | 180 cal**
diced tomatoes, potatoes, yellow zucchini, zucchini, carrots, peas, onions, broccoli, corn, celery, mushrooms and red bell peppers simmered in a vegetable broth

**Beef & Vegetable Stew | 340 cal**
chunks of tender beef simmered in a burgundy laced gravy with pearl onions, celery, tomatoes, petite carrots and russet potatoes

**Turkey Chili | 330 cal**
a hearty medley of ground turkey, black beans, corn and a variety of peppers with just a touch of spice

**Broccoli Cheddar | 340 cal**
chopped broccoli and broccoli florets simmered in a velvety chicken broth seasoned with grated cheddar cheese, herbs and sweet onions

**Chicken Noodle | 120 cal**
chicken breast simmered in a chicken broth with tender egg noodles, carrots, onions, celery and select herbs

## SALADS

**Chicken Cobb Avocado | 460 cal**
antibiotic free chicken, romaine & field greens, fresh avocado, hardwood smoked bacon, gorgonzola, egg, tomatoes, cucumbers & avocado green goddess dressing

**Vegetarian Deluxe | 260 cal**
romaine & field greens, roasted peppers, kalamata olives, feta, tomatoes, cucumbers, carrots, chickpeas, red onions & balsamic vinaigrette

**Chicken Caesar Asiago | 290 cal**
antibiotic free chicken, romaine, housemade croutons, asiago cheese & caesar dressing

**Thai Peanut Chicken | 250 cal**
antibiotic free chicken, romaine & field greens, tomatoes, cucumbers, carrots, crispy wontons & thai dressing

**Harvest Turkey | 380 cal**
antibiotic free roast turkey, romaine & spinach, cranberries, grapes, granny smith apples, goat cheese, walnuts & balsamic vinaigrette

**Southwest Chicken | 380 cal**
antibiotic free marinated chicken, romaine, black beans, roasted corn, fresh avocado, cucumbers, tomatoes, crispy wontons & citrus lime vinaigrette

## SALAD DRESSING

**Balsamic Vinaigrette | 80 cal**

**Caesar | 190 cal**

**Ranch | 180 cal**

**Citrus Lime Vinaigrette | 110 cal**

**Chili Lime Vinaigrette | 110 cal**

**Thai | 120 cal**

# SANDWICHES

## SIGNATURE & OVEN HOT SANDWICHES

**Two Tomato Caprese | 570 cal**
on ciabatta—with fresh mozzarella, tomato basil bruschetta, tomatoes, arugula & balsamic vinaigrette

**Chipotle Turkey & Avocado | 770 cal**
on ciabatta – antibiotic free turkey with fresh avocado, ny cheddar, tomato basil bruschetta, arugula & chipotle mayo

**Ham & Two Cheese | 570 cal**
on multigrain - with ny cheddar, swiss, tomatoes, arugula & dijonnaise

**Newport Turkey | 730 cal**
on country white – antibiotic free turkey with fresh avocado, ny cheddar & a touch of zesty honey mustard

**Toasted Chicken & Avocado | 730 cal**
on toasted semolina - with hardwood smoked bacon, fresh avocado, tomatoes, field greens & basil aioli

**Chipotle Black Bean Burger with Avocado | 740 cal**
on ciabatta - ny cheddar, fresh avocado, pickled red onions, tomatoes & chipotle mayo

**Country Grilled Cheese | 550 cal**
on country white - with four cheese blend, hardwood smoked bacon & tomatoes

**Classic Grilled Cheese | 490 cal**
on country white, with four cheese blend & tomatoes

**Smoky BBQ Chicken Melt | 650 cal**
smoky bbq marinated chicken with melted ny cheddar, zesty spread and vidalia coleslaw served on rustic baguette

## WRAPS

**Napa Chicken With Avocado | 590 cal**
antibiotic free chicken with fresh avocado, tomatoes, cucumbers, romaine, basil aioli & lemon vinaigrette

**Thai Peanut Chicken | 560 cal**
antibiotic free chicken with tomatoes, cucumbers, carrots, crispy wontons, romaine, field greens & thai dressing

**Chicken Caesar | 560 cal**
antibiotic free chicken with asiago cheese, romaine & caesar dressing

**Veggie & Hummus | 540 cal**
with hummus, cucumbers, tomato bruschetta, carrots, chickpeas, romaine, field greens, feta & balsamic vinaigrette in a whole wheat wrap

**Sweet Turkey Wrap | 580 cal**
with ny cheddar, apple cabbage slaw, field greens and smoky bbq sauce in a whole wheat wrap


**Assessment of categorical motives**

1. Please select **all** of the reasons for reducing meat consumption that are compelling to you.
    a. Improved health
    b. Weight-loss
    c. Animal welfare
    d. Religious and spiritual beliefs
    e. Environmental reasons
    f. Taste preference (aversion)
    g. Lack of access to meat and/or animal products (constraints)
2. Please rank the following reasons for reducing meat consumption from most-compelling to least-compelling.
    a. Improved health
    b. Weight-loss
    c. Animal welfare
    d. Religious and spiritual beliefs
    e. Environmental reasons
    f. Taste preference (aversion)
    g. Lack of access to meat and/or animal products (constraints)

**Rosenfeld & Burrow Dietarian Identity Questionnaire Motives Subscales**

In general, which of the following food groups do you **not** eat. Please select all that apply. If you generally eat all of these food groups, please select the last response.

1. I generally do not eat red meat
2. I generally do not eat poultry
3. I generally do not eat fish
4. I generally do not eat dairy
5. I generally do not eat eggs
6. I generally eat all of these food groups

For the rest of this survey, please note that your "dietary pattern" represents those foods you indicated about. For example, if you selected "red meat" and "dairy," your dietary pattern excludes red meat and dairy. If you selected the last response, your dietary pattern includes all of these foods.

Please indicate how strongly you agree or disagree with each of the following statements. [seven-point scale, strongly disagree to strongly agree]

1. I view my dietary pattern as a way of making the world a better place for others.
2. Concerns about social issues motivate me to follow my dietary pattern.
3. I follow my dietary pattern because I want to benefit society.
4. I feel motivated to follow my dietary pattern because I am concerned about the effects of my food choices on other beings.
5. I am motivated to follow my dietary pattern because I want to help others.
6. I follow my dietary pattern because eating this way is good for the world.
7. I follow my dietary pattern because I am concerned about the effects of my food choices on my own well-being.
8. I follow my dietary pattern because eating this way improves my life.
9. When thinking about which animal products to consume, I consider the effects of my food choices on my own health.
10. I feel that I have a moral obligation to follow my dietary pattern.
11. I am motivated to follow my dietary pattern because eating foods that go against my dietary pattern is immoral.
12. I follow my dietary pattern because eating this way is the morally right thing to do.